# THE IRON AGE — October 11, 1934



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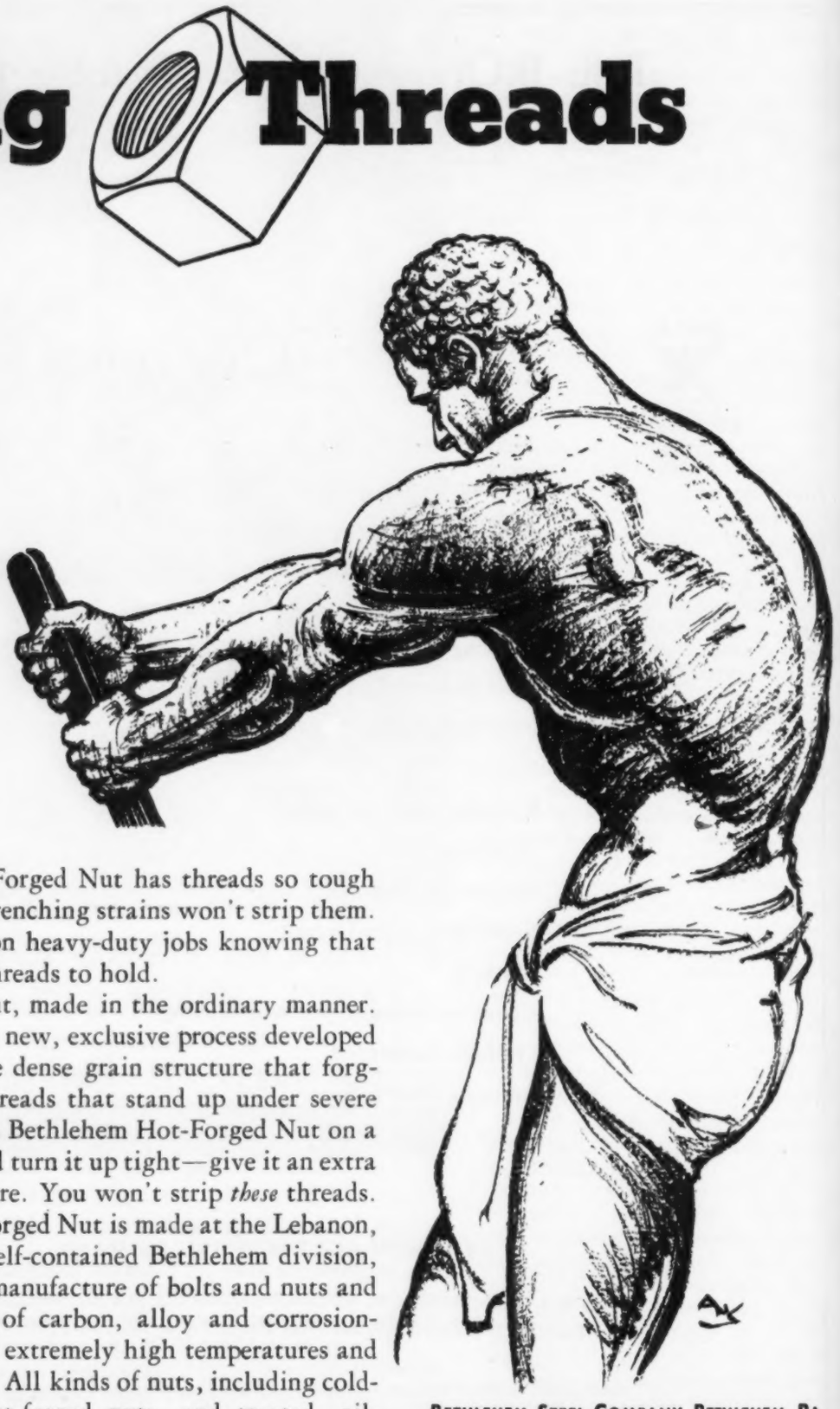

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▲▲▲ THE IRON AGE ▲▲▲

OCTOBER 11, 1934

ESTABLISHED 1855 Vol. 134, No. 15

# Billion Dollar Words

IT is well to remember that those measures of Government participation in private enterprise that we now condemn were largely invited by business itself. Frightened business, in the hurricane of depression, sought a Government refuge; a storm cellar where it might escape the devastating winds of competition. In seeking this refuge, the refugees did not realize that there might be a spring lock on the outside of the cellar door.

There is not room, in that storm cellar, for the necessary play of competitive initiative that provides the impetus for common progress, that enlarges the purchasing power of pay envelopes and that finances new jobs for workers. Business is gradually finding this out and we believe that Government is too.

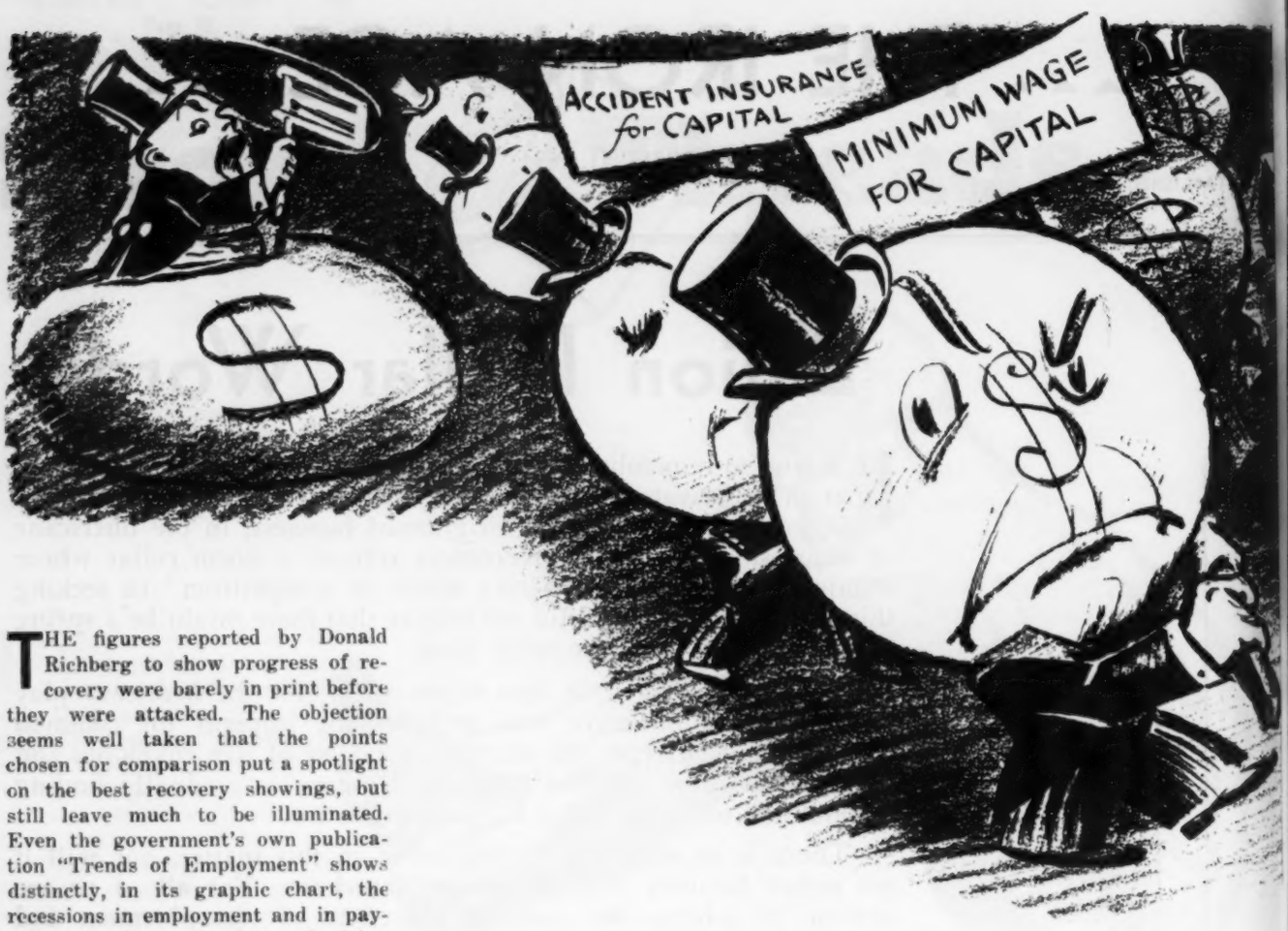
There is no need for recrimination in this matter, nor will it get either business or Government anywhere. For all of us are anxious to achieve the common objectives of reemployment and increased activity. The Government would doubtless be as glad to see stock market prices go up and stay up as would the holders of such securities.

To this end, intelligent experimentation should not be condemned. The danger is not in experimenting, but in sticking to experiments that do not work.

Respectfully, therefore, we suggest an experiment that can be tested overnight; that will cost little and may accomplish much. It is that there be administrative announcement to the American public of the following intention:

*It is the firm purpose of this administration to withdraw, as rapidly as possible, both Government participation in private business and Government competition with private business. This will be done, of course, without relinquishing those measures of Government regulation which are necessary to protect the general public interest."*

If these words should come to the American public from the President's fireside, they will put more men to work during the next six months than all of the billions of dollars that have been spent for that purpose during the past year and a half. For they will break, as effectively as dynamite, the log jam of fear which is damming up our great reservoir of private enterprise and that is keeping ten million men out of employment.




# GETTING CAPITAL

By H. P. LOSELY

THE figures reported by Donald Richberg to show progress of recovery were barely in print before they were attacked. The objection seems well taken that the points chosen for comparison put a spotlight on the best recovery showings, but still leave much to be illuminated. Even the government's own publication "Trends of Employment" shows distinctly, in its graphic chart, the recessions in employment and in payrolls—the latter in face of rising prices. As long as conditions obstruct continuous re-absorption of the unemployed, we should not boast about recovery. That re-absorption might show a varying rate, but when instead it shows such frequent relapses, it would indicate that our recovery course is not yet properly charted.

The executive in private enterprise still finds the conditions facing him much more faithfully reflected in the business indices which have served him well in the past. The operating rate of blast furnaces and steel mills has shown recessions. Carloadings since July have fallen below last year's figures—and since normally some two-thirds of railroad tonnage is for the production of durable goods, I regard carloadings as the best quick barometer of recovery.

Colonel Ayres said not long ago that a depression might well be described as a period during which there is a long and important decrease in the making of durable goods. It is becoming widely recognized that genuine recovery depends on a wide revival of the capital goods industries, where unemployment is still concentrated. By the very nature of the business, these industries have, on the whole, not only the highest paid workers with the highest degree of skill, but also more of the type of leader trained in creative reconstruction. On the other hand, the production of consumption goods is a business which necessarily breeds more routine operators who have had to concentrate on sound trading principles and efficient merchandising, but usually rely on outside talent for new engineering work. If therefore the initiative to concerted remedial action is coming largely from the durable goods industries, it is not only because they have more at stake, but that they can supply the means for lifting standards of living, which after all is just another way of expressing a widening use of durable goods.

### Capital on a Dole

There is no longer any doubt that a vast amount of capital is virtually out of work, or on a dole—through no fault of its own! It is being suggested that capital is on strike. Yet it is rather immaterial whether it is on strike or locked out; the real issue is to remedy the conditions that keep it employed at starvation wages or make-shift work. Perhaps capital needs a minimum wage and compensation insurance against industrial (or political) accidents!

# BACK TO WORK

▼ ▼ ▼

It has been aptly said that there is nothing so timid as a million dollars. That may sound like a sarcastic wisecrack, but should rather suggest the basic cause for the proverbial timidity of the investor. That is the inescapable fact that wealth sunk into a permanent investment is irretrievable; the crystallization of labor into any form of fixed assets is an irreversible process; salvage of all but a minute portion is impossible. That fact is often disguised by making the claims on the assets financially liquid. But no financial disguise can provide an incentive to the creation of fixed assets without assurance to the builder that he can enjoy the fruits of his endeavor. In commercial operation, the investor can only retrieve his original capital by using the fixed assets to make profits; when the profits or prospect of profits cease, the assets are valueless. That may seem elementary, but at a time when profits are being attacked, it needs clear statement.

## True Profits

Even a collectivist economy—if it is to achieve progress—cannot afford to disregard the profit-motive. True profits—as distinguished from plunder—are obtained by making two blades of grass grow where one grew before. There is never an end to possibilities of that description, but none of them endure forever. They cease when the new method and ability to apply it become common property. So to continue making profits we have to continually exercise our ingenuity and maintain above-average ability. Not the least part of the profit calculation is the time element—how long will the profits be secure? Will they continue long enough to retrieve at least the original capital sunk to exploit a new method, with a margin of safety left for fresh experimentation? The need for some degree of protection was long ago recognized by inauguration of the patent system—and recently by design registration to curb piracy. It may prove equally necessary to recognize the need for protection of capital against excessive competition.

In previous articles in THE IRON AGE, I have brought out the fact that there is close relationship between wages paid to labor and the capital investment required to make high wages feasible. On an overall basis, the minimum investment in competitive industry where obsolescence risk is high, seems to be three times the annual wage bill. In monopolistic enterprise, where those risks are much lower, the ratio of investment to wages goes much higher. To provide avenues for profitable employment of capital, there are therefore two cardinal principles which should be considered in our industrial reorganization.

(a) We must encourage the shift in each industry away from poor methods tied to low wages. Efforts must be made to bring up the performance of the poorest units of an industry at least up to the present average.

(b) We must face squarely the serious problem of obsolescence ex-

penses of competition, since they too frequently eat away all profits. If they can be brought under some degree of control, we may be able to raise the amount of capital used per worker—with gains to both owner and worker.

### The Labor Situation

Although this discussion is primarily to deal with the economics of getting capital back to work, the present labor situation cannot be left without mention. When a labor union goes on a rampage with a strike against all plants of an industry, regardless of how well the individual management is doing its job, and with existing contracts "spurlos versenkt," it is adding immeasurably to the difficulties for all labor—if for no other reason than making it more difficult to interest owners in putting in the very capital necessary to raise wages.

There have been in recent years practical demonstrations that unions with a sense of responsibility and perception of business economics can be a very helpful force. It does not seem material whether the union is a purely company one (e.g. the B. & O. shops) or one with wider affiliations (e.g. Rocky Mountain Fuel Co.), provided the leadership of the union within the company and the management get down to real cooperation, and by improving individual output, instead of restricting it, make it possible to better economic conditions. That sort of cooperation is not mere acquiescence of one to the other, but a real thrashing out of the consequences of policies, to devise mutually advantageous arrangements. It leaves both parties satisfied that each is getting the most that can be had on a permanently paying basis. The guiding motive of all such efforts is that the customer must be pleased. The public provides the business, and when cooperation in production renders greater consumer satisfaction, increased volume will provide the basis for increased reward to capital, management and labor.

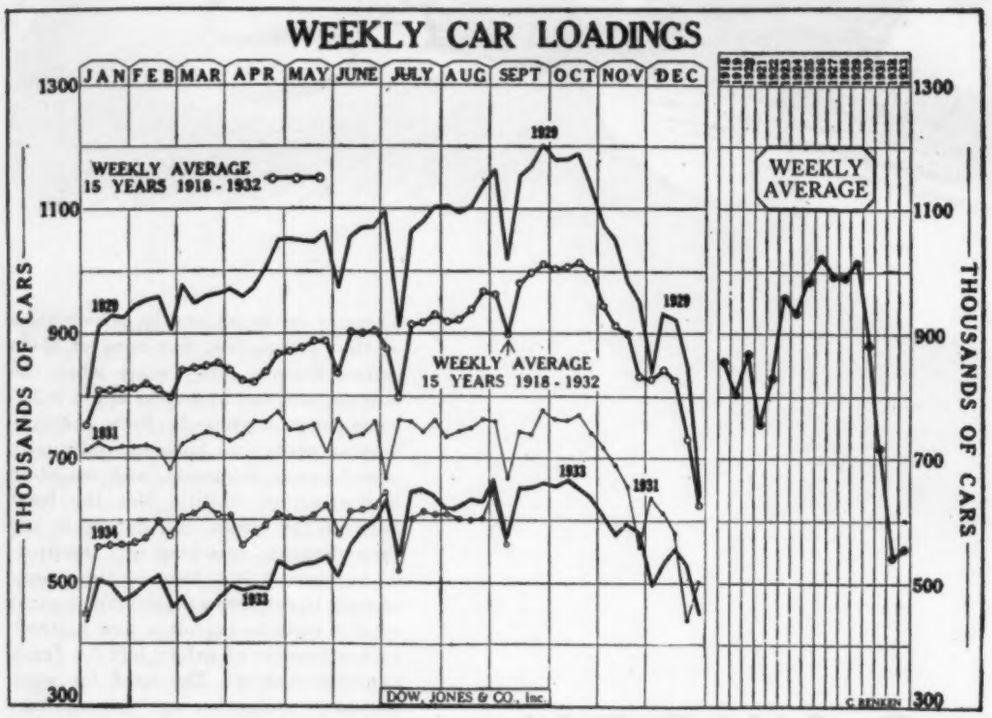
Experience seems to indicate that the resolving of internal conflict into successful cooperation needs a catalytic agent in the form of fresh blood. The complaints of the small one-company community are often traceable to long inbreeding, both of staff and workers, and attempts to continue with outmoded methods. That inevitably has led to gradual, even imperceptible sacrifice of living standards, as the price of staying in the running at all. We have in many cases now as acute a conflict between different standards of living within our own borders, as against supposedly inferior standards against which we erect a tariff.

### "Company" Unions

For that reason, I hardly believe that the isolated company union is going to be the ultimate answer for industrial peace. Some interchange of experience in developing workable cooperative plans may be as essential to the education of the worker as it is to that of managers. One of the leading trade association organizers has testified to the rapidly broadening outlook of many small-scale industrialists, since they learned to sit down with one another to discuss common problems.

Is it too much to hope that if some of the company union leaders could meet with others who have achieved results through cooperation, they might learn wise tactics—that progress is not made by making unconsidered demands, but by tackling the hard facts with which their industry has to contend—that wages can only be paid out of production, and that in turn depends on keeping up with the march of progress?

The bare economic difficulties are hard enough to solve without the turmoil of general strikes. Wise labor leadership would avoid the latter as a pestilence. What it ought to do is to concentrate on the exceptionally bad examples, and seek out methods for remedying those situations locally. If it finds in the last resort that its troubles are a Bourbon management that knows nothing and learns nothing, it should by that time be able to present a case buttressed with comparative results of what is being done elsewhere. With such an approach, it would have on its side, not only public sympathy, but also that of many employers who suffer equally from the presence of parasites who contribute nothing to purchasing power. Without giving up the right to strike, after fulfilling contracts, I believe even such cases would yield to pressure without that last resort.




Weekly car-loadings showing 1928, 1929, 1933, 1934

### Minimum Wage Difficulties

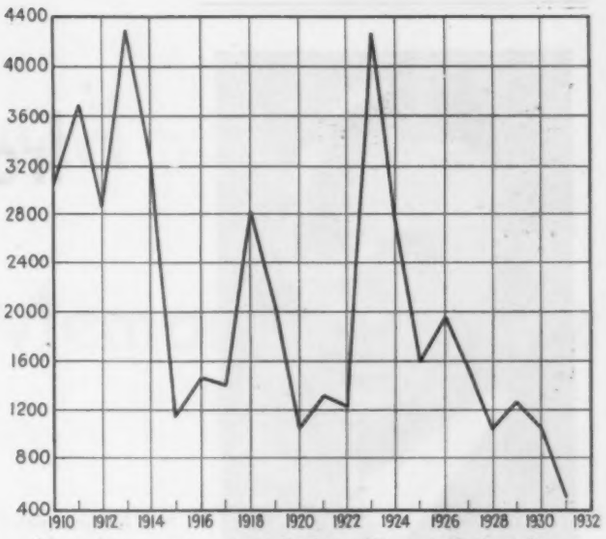
It must in any case be clear that if minimum wages in an industry are set high enough to be fair for the majority, the imposition of such rates on the backward unit is bound to create difficulties. It is easy to say that the company unable to pay those wages has no right to exist. But it is obvious that cracking down methods, of which we have heard much and

seen only a microscopic amount, are not going to be workable when it comes to dealing with a unit which is the sole source of outside cash in a community. What is needed is not extermination but rescue. What industry may have to do to enforce its codes is to provide some of these marginal concerns with a receiver who can re-organize them—even if on a different scale—without irreparable damage to the community. It may often result in a greater cash income, but with less employed in the mill and more in non-industrial work.

Many industries suffer intensely from the existence of surplus obsolete equipment, which can only be kept in operation by paying inadequate wages. I believe we will have to devise means of retiring such impedimenta to industrial health—but with each industry doing its own clean-up job. Only recently the Lancashire cotton mills have proposed just such a step, with a plan to junk closed mills demonstrably worthless, and a further retirement of some obsolescent mills just on the border-line—although they hope to saddle some of that on to the taxpayer via subsidy. That should not be necessary. Some years ago Mr. Ford contributed much to stopping the practice of abandoning old cars on the highway by offering cash for them, and then extracting it by systematic reclamation of material. Our industries have enough ingenuity to devise a similar retirement of antiquated machinery—provided the legal framework is adjusted to permit it. The replacement of such obsolete machinery by more efficient tools is a key item of any program to provide the higher wages needed for sustained recovery.

## Durable Goods and Consumption Industry's Wages

To the durable goods industries, the provision of good wages in the consumption industries is of primary importance. In the depths of the depression a leading textile manufacturer complained to me that the engineer was not making his equipment obsolete rapidly enough! No, he was not foolishly inclined to spend money merely to have shiny machinery—what he wanted was something to help him outdistance his sweatshop competitor. But at that time weavers in New England were working for $7 a week.



New locomotives installed in Class I Railroads.

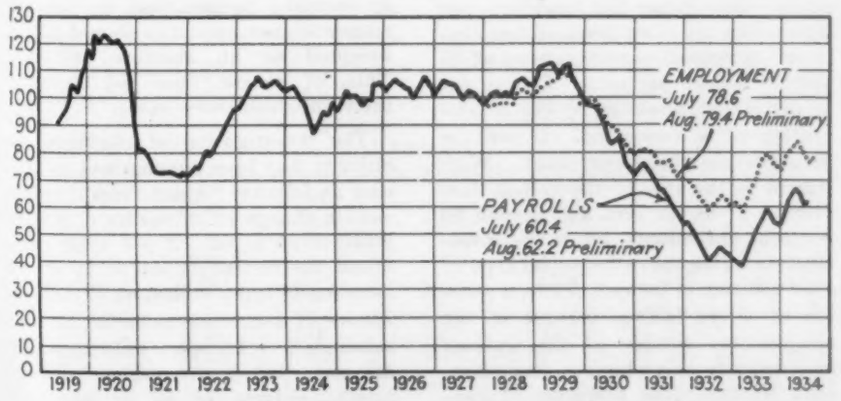
Professor Warren once went out of his way to gibe at engineers who turned from bridge-building to economics. Well, at least our bridges stay up—and every development engineer has perforce always been obliged to spend much time with practical economics. He knows very well that a new machine, must economically justify itself. And when for example, textile wages were so drastically pared, the problem of designing new weaving machinery ceased to be a study of kinetics and became a stunt of working miracles. We are now seeing a repercussion of increased weaver wages—looms designed and tested several years ago are now becoming economically feasible and are being actively installed.

## Technological Progress and Wages

It is no accident that the rate of technological progress is most marked in those industries where high wages prevail. Taking a few examples out of the biennial census figures from 1923 to 1929, we find for instance cotton textiles and canning plants, with average annual wages around $800, show an almost stationary value added per man employed. On the other hand, blast furnaces, steel mills, motor vehicles, which all had average wages around $1,600-$1,700, showed increments of value added of around 6 per cent annually.

It is much to be regretted that no comparable statistics are available on the investments made in these different industries which would help us to judge how much of this increased productivity was due to new tools, and how much to increased efficiency of the men through attention to better training, accident prevention and personnel management. But at least we know that of the ten billions of new industrial securities (this does not include any utilities) issued in that period, most of it was directly connected with the durable goods industries, and provided employment for the high-skilled workers with rising levels of earnings, while in the same period, the already low wages in the consumption goods industries were even then showing falling tendencies.

So it should be clear that the consumption goods industries themselves have a double interest in sound methods of raising their average real wage levels. Not only will added purchasing power of their own workers ease their sales problems, incidentally decreasing sales expenses, but by making it feasible to use further labor-saving devices, it will cause a tremendous revival in the durable goods industries, thus regaining as normal customers, the best paid group of workers now so largely without jobs and income.



Trend of employment and payrolls

## Management of Machinery

What will need continued attention is the hard task of managing our labor-saving devices so as to really

*(Continued on Page 88)*

# Iron-Chromium Alloy

VSEVOLOD N. KRIVOBOK studied at the Polytechnical Institute of St. Petersburg. Following the Russian revolution, he studied metallurgy at Harvard, where he was granted the B.S., M.S. and Sc.D. degrees. Dr. Krivobok has been on the staff of the Carnegie Institute of Technology for ten years. As a member of the research staff of the bureau of metallurgical research, he investigated many metallurgical problems pertaining principally to special steels. He has published numerous papers in technical journals on chrome nickel alloys, and has served as consultant in testing special steels and as technical adviser to a manufacturer of stainless steels.

FOR several years the alloys of iron and chromium have been examined at the Carnegie Institute of Technology, Pittsburgh, and much of the data secured at that institution was presented by V. N. Krivobok in the Edward deMille Campbell Memorial Lecture as delivered before the American Society for Metals, the American Institute of Mining and Metallurgical Engineers and affiliated societies at the Hotel Pennsylvania, New York, on Oct. 3.

Doctor Krivobok opened his lecture with a historical sketch of metallurgy and then reviewed the present status of iron-chromium metallurgy. Instead of using the usual lantern slides, the lecture was greatly enhanced by the use of animated motion picture diagrams in order to present the great mass of complex experimental data more attractively. Quite generous extracts of more important phases of the lecture are as follows:

After a brief review of the existing pertinent data for chromium alloys some of the recently secured observations and brief discussions concerning them will be presented. If you should find in them leads for further scientific researches or for conquest over some of the industrial problems, I would like to think that the duty coincident with the honor of being a Campbell lecturer has been fulfilled.

Before submitting the results pertaining to anomalies found in iron-chromium alloys, the basis for the assertion that these alloys are of solid solution type should be stated. This basis is found in the work of Oberhoffer and Esser, Kreutzer, Westgren, Phragmen, and Negresco, Chevenard, and more recently of Preston, and Wever and Jellinghaus. The X-ray method was employed and type of lattice as well as its dimensions at room temperature were ascertained.

I have come to the conclusion that iron and chromium form, at room temperature, an *uninterrupted* series of solid solutions from the iron end to the chromium end. The results of dilatometric work by Chevenard, the discovery of a "brittle" constituent by Bain and Griffiths, and the latest work of Wever and Jellinghaus indicate the formation of an iron-chromium compound, the range of stability for which lies, at room temperature, between chromium concentrations of 38 and 60 weight per cent. Let us not be distracted, however, by the consideration of a compound. It will be brought into discussion later. With regard to the rest of the system (i.e. from 0 to 38 per cent and beyond 60 per cent chromium), all of the investigators agree that substantial type of solid solution is formed. Thus, a number of alloys falling, because of the composition, outside of the gamma loop, solidify as alpha-iron-chromium-solid solution (the assertion of Janecke concerning the formation of iron-chromium eutectic, now being discarded) and remain as such upon cooling to room temperature. It is in these alloys of iron with chromium that the *gradual* variation in properties would be expected. The authors of numerous studies, however, submit experimental results difficult to reconcile with the frequently accepted "nature of the alloys." The curve of lattice parameter (Preston's) has been verified on several alloys in my laboratory, and it exhibits a marked change of slope at about 7 atomic per cent of chromium. Above 20 per cent the numerical data are less consistent, but the other line could conceivably be drawn tangential to the curve at a point corresponding to about 22 per cent chromium.

Among the additional data the magnetic are of interest. Most of the magnetic experiments were concerned with the determination of $A_2$ or Curie point. The results of Fischer show a pronounced maximum for permeability at about 18.5 per cent chromium.

A plotting of Preston's data secured at low magnetizing forces shows definite scattering of points. With increased magnetization his curves flatten out. The results of these workers do not justify any definite conclusions. Magnetic results are affected by so many factors that, in general, magnetic characteristics should not be accepted as an absolute criterion. This, of course, does not diminish their supplementary value.

The investigation of electrical resistivity has been summarized by Adcock as follows: "Apart from a rather sudden change of curvature at a composition of about 12 per cent chromium the resistivity curve is of the inverted-U type, indicative of the existence of a continuous series of solid solutions." Adcock, unfortunately, did not explore the region of most interest — from 18 to 38 per cent chromium.

# Experiments Reviewed In Campbell Memorial Lecture

Dilatometric observation by Murakami and his workers, Chevenard, Wever and Jellinghaus, among the most recent, were confined primarily to the gamma loop region and to the alloys where the formation of a previously mentioned compound was suspected. No attempt was made to explore the region immediately beyond the alpha and gamma region, and furthermore, no precautions were taken to ascertain that sufficient time was allowed for the reaction to proceed. As a consequence no conclusion was drawn concerning the alloys of single-phase type.

A striking proof of either an inadequacy of the diagram or of our incomplete picture of the nature of solid solutions and their inherent characteristics comes from the studies of mechanical properties. While strength and ductility (in tension) vary in a normal, gradual manner as we progress from one alloy to the other, higher and higher in chromium, toughness (viz., resistance to impact) disappears, for all practical purposes, around 18 per cent chromium. Lest it should be misunderstood, I wish to explain that, by carefully conducted, we may even say "special" treatments, the toughness even at this concentration can be improved. This is in itself a very important observation, but that is *not* the point. The fact remains that neither the loss of toughness under normal or ordinary conditions of treatment nor its return after special treatment is explained by the usual concepts of the nature of the alloys.

### Preparation of Alloys Described

A searching investigation into the innermost *essence* of metallic bodies is a most formidable task, immeasurably lightened by progressive elimination of possible variables. The influence of even minute amounts of impurities is so well recognized as one of such variables. It must, regretfully, be admitted that in some of the cases cited above the investigated alloys were lacking in purity. Obviously, if additional experimental data were to be sought, they should be secured from a series of alloys in which the impurities were reduced to a minimum. With this purpose in view, extra precautions were taken. The alloys were melted in vacuo, using as ingredients hydrogen-purified iron and the best available electrolytic chromium or ferro-chromium, both practically carbon free. The ingots were forged and subsequently homogenized at 1250-1300 deg. C. in argon (from 10 to 20 hr.). The final chemical analyses are shown in Table 1.

Two values in any column in Table I for one alloy represent the widest variation in the results of chemical analysis at different parts of the bars. Such impurities as silicon, manganese, nickel, sulfur, and phosphorus were present merely as "traces," and therefore are not included.

Some concern was caused by unexpectedly high oxygen in several of the alloys. It was ascertained, however, that most of the determined oxygen came from small particles of alumina which became detached from the walls and bottom of the crucibles and were mechanically held within the ingots. When these inclusions were extracted and analyzed, the total oxygen was found to be virtually the same as in corresponding ingots. The metal property, therefore, is assumed to be practically oxygen free. Carbon was as low as was possible to obtain. These alloys will be referred to in future discussion as *carbonless*.

In addition, a series of alloys was made in an Ajax experimental furnace, using the usual procedure for deoxidation, etc. These alloys analyzed as shown in Table II.

The available material, it was hoped, would afford an opportunity for the following:

(a) To ascertain the characteristics of fairly pure carbonless alloys, and, thus to judge the adequacy of the diagram.

(b) To establish the parallel, if any, between carbonless and commercial alloys, noting, thereby, the influence of impurities, including carbon.

The ultimate in research work should not only be the answer to the question *what*, but also to the question *how*. The experimental procedure was decided upon with this

**TABLE I**

| Alloy Designation | Analysis, Weight Per Cent | | | | | Other Impurities |
|---|---|---|---|---|---|---|
| | Cr | C | $N_2$ | $H_2$ | $O_2$ | |
| F 12 | 11.82 | 0.01 | 0.004 | Less than | 0.020 | nil |
| | | 0.006 | 0.005 | 0.0005 | | |
| W 14 | 12.93 | 0.01 | 0.004 | 0.0002 | 0.046 | nil |
| | 12.99 | 0.008 | 0.005 | | | |
| W 16 | 14.94 | 0.008 | 0.003 | 0.0006 | 0.03 | nil |
| | 15.04 | 0.009 | 0.007 | | | |
| F 18 | 17.50 | 0.010 | 0.016 | Less than | 0.031 | nil |
| | 17.39 | 0.010 | 0.015 | 0.0005 | 0.032 | |
| F 20 | 18.13 | 0.012 | 0.009 | | | nil |
| | 18.26 | 0.009 | | | | |

TABLE II

| Heat No. | Analysis, Weight Per Cent | | | | | | |
|---|---|---|---|---|---|---|---|
| | C | Mn | Si | P | S | Cr | Ni |
| 68 | 0.030 to 0.030 | 0.39 | 0.20 | 0.011 | 0.013 | 14.28 | 0.10 |
| 69 | 0.098 to 0.104 | 0.28 | 0.31 | 0.013 | 0.010 | 14.63 | 0.10 |
| 70 | 0.194 to 0.196 | 0.35 | 0.30 | 0.010 | 0.013 | 14.74 | 0.11 |
| 71 | 0.023 to 0.025 | 0.35 | 0.27 | 0.010 | 0.014 | 16.66 | 0.10 |
| 72 | 0.103 to 0.104 | 0.35 | 0.29 | 0.011 | 0.011 | 16.84 | 0.12 |
| 73 | 0.147 to 0.148 | 0.31 | 0.26 | 0.012 | 0.015 | 16.56 | 0.14 |
| 74 | 0.191 to 0.191 | 0.35 | 0.29 | 0.006 | 0.013 | 16.74 | 0.14 |
| 75 | 0.021 to 0.023 | 0.37 | 0.32 | 0.008 | 0.013 | 18.84 | 0.13 |
| 76 | 0.102 to 0.103 | 0.36 | 0.27 | 0.010 | 0.008 | 18.84 | 0 17 |
| 77 | 0.155 to 0.158 | 0.34 | 0.32 | 0.011 | 0.010 | 18.55 | 0.14 |
| 78 | 0.202 to 0.207 | 0.36 | 0.30 | 0.010 | 0.014 | 18.77 | 0.16 |
| 79 | 0.028 to 0.032 | 0.35 | 0.25 | 0.010 | 0.012 | 20.61 | 0.15 |
| 80 | 0.078 to 0.082 | 0.35 | 0.34 | 0.011 | 0.009 | 20.68 | 0.18 |

idea in mind. Impact resistance and hardness (from among mechanical properties), dilatometric observations, microscopic examination and X-rays were selected to ascertain the characteristics; age-hardening, followed by microscopic and X-ray study, mechanical characteristics at subnormal and slightly elevated temperatures were then ascertained in an attempt to answer the question *how*.

## Toughness Disappears Also in "Carbonless" Alloys

Alloys on which impact values were obtained were heat treated in several ways thought to be the best for the purposes of investigation. In each case the relative *trend* was quite the same.

It was found that the abrupt disappearance of toughness is just as evident in "carbonless" as in alloys fairly high in carbon. Furthermore, the loss of toughness is not, so far as could be ascertained, gradual, but asserts itself within a very narrow range of chromium concentration, which is substantially the same for all alloys, irrespective of their carbon content.

From these observations it was concluded that purity and, specifically, carbon, play no part in the sudden change of toughness.[1] The explanation should be sought either in some radical change in the constitution of the alloys or in some other factor as yet undiscovered.

Ordinarily an abrupt change in one mechanical property indicates similar, but not necessarily of the same sign, changes in others. Concurrent loss of ductility and gain of hardness in most of the steels is a well-known illustration. It does not apply, however, to alloys of chromium. In both the very low and the (fairly) high carbon series the change in hardness (with increasing chromium) is gradual and relatively small. Other mechanical properties will be found to vary much in the same manner as hardness (if care is taken to give the alloys proper heat treatment). See Table IV.

As is known, grain size is controllable and also measurable. In these vacuum melted carbonless alloys of chromium the grains are remarkably large. To break up these grains is no easy matter, but can be accomplished by repeated mechanical working. The fact that the sudden drop in toughness is independent of grain size was clearly demonstrated by testing two alloys with grains averaging respectively 0.2 and 4.0 square millimeters. The results of the tests were, for all practical purposes, identical.

There is no relation, for the same carbon content groups, between impact strength and grain size. These results must not be, however, misunderstood. We are discussing the abrupt appearance of impact brittleness, and its independence of the grain size. In a given alloy, if it contains less than a certain, critical amount of chromium, the resistance to impact (and, of course, other properties) may be considerably improved by grain refinement, as should be expected. But in alloys, in which the impact brittleness appears to be an inherent characteristic, the grain size alone is of no consequence.

[1] It is not to be inferred from this statement that carbon has no influence at all. It has definite influence in those alloys which lie to the left of that "critical" concentration of chromium where toughness vanishes.

TABLE III

| Sample No. | Analysis | | Impact, Foot Pounds | |
|---|---|---|---|---|
| | C Per Cent | Cr Per Cent | Heated to 1450 Deg. F. for 3 Hr., Air Cooled | Heated to 1450 Deg. F. for 3 Hr., Aged at 914 Deg. F. for 200 Hr. |
| 68 | 0.03 | 14.28 | 175 | 129 |
| 70 | 0.19 | 14.74 | 34 | 62 |
| 71 | 0.02 | 16.66 | 132 | 4 |
| 74 | 0.19 | 16.74 | 44 | 25 |
| 75 | 0.02 | 18.84 | 85 | 2 |
| 76 | 0.10 | 18.84 | 73 | 3 |
| 78 | 0.20 | 18.77 | 12 | 3 |
| 79 | 0.03 | 20.61 | 11 | 2 |
| 80 | 0.08 | 20.68 | 7 | 2 |

## Lattice Parameters Are Checked

In view of the careful X-ray work, reported in previous investigations, the efforts of our laboratory were confined to checking lattice parameters of one or two alloys. When it was found that our measurements checked those of Preston, further work along this line was discontinued.

Microscopic examination revealed the typical structure of solid solutions, with, apparently, no visible change whatsoever as we pass from tough to brittle alloys. One observation is worthy of note: Distortion, such as that resulting from cold work of ferrite and ferrite bearing steels, is revealed on a polished section by the presence of characteristic wavy strain lines. In the alloys under investigation, strain lines are altogether different. They are straight, comparatively few in number, and oftentimes intersect each other at different angles, (similar to Fe-Si alloys).

The proof of the phase change occurring in the alloy with 12.99 per cent chromium is given by the noted failure of heating and cooling curves to follow the same course, although at the end of the experiment the sample comes to its original dimensions. In alloys of 15, 17.5, and 18.2 per cent chromium, however, the path and the slope of the cooling and heating curves are identical. Thus, we may conclude that the end of the gamma loop lies somewhere between 13 and 15 per cent chromium, as generally accepted.

Recent unpublished investigations of chromium steels reveals that the rates of transformation in these steels are very low, especially if the transformation does not involve the formation of eutectoid (low carbon steels). Consequently, the conclusion with regard to gamma loop limits, or whatever other information the dilatometric curve may present, will not be justifiable unless the experimental procedure was such as to insure at any given instant an approach to equilibrium.

In performing dilatometric studies

upon alloys in which the reaction velocity is low, or in which the amount of the transformed phase is small, it is obligatory to use very low rates of heating and cooling. An alternative may be found in subjecting the alloys to "holding" at any selected temperature at which the phase change may be expected. If the expectation is fulfilled and the reaction does proceed at this particular temperature, plotting the change of length against time will give an *approximate* idea of the rate of reaction.

The alloy of 12.99 per cent chromium, upon holding at 1000 deg. C. for 3 hr. undergoes definite contraction and a formation of gamma phase. Subsequent cooling produces a definite break in the opposite direction which indicates a *slow* transformation of the formed gamma back to alpha. By holding the sample at the temperature corresponding to the beginning of the break as much of the transformation will occur in attaining equilibrium as is allowed by the phase rule. Upon further lowering of the temperature and holding, the transformation will proceed again because an alloy of this composition falls within the field of two phases, the relative amounts of which are governed by the temperature.

The fact that this alloy did not come back to its original length can be explained in part by the previous history of the sample: It was not in true equilibrium when the original heating was begun. Similarly performed experiments on alloys with 15.0 and 17.50 per cent chromium yielded, except for magnitude, identical results. Definite contraction of the alloy with 17.50 per cent chromium occurs on holding either at 1000 deg. C. or 1070 deg. C. Also a different path (with a pronounced break) of the cooling curve and subsequent return of the sample, upon slow cooling, to its original dimensions should be accepted as a well-founded indication of phase change, affecting, in all probability, but a very small portion of the sample.

In the alloy with 18.20 per cent chromium, the magnitude of the transformation at high temperatures was found so small, even after prolonged holding, as to be hardly perceptible.

Without any attempt, at the moment, to explain these experimental results, the conclusions as to laboratory facts are as follows:

(a) At a certain chromium concentration, alloys of fair purity are characterized by rapid modifications in some of their properties. This change is not governed either by carbon percentage or by impurities in the ordinary sense of the word.

(b) Further, these alloys, contrary to orthodox understanding (the Curie or magnetic point is not considered), undergo some transformation which may or may not be a simple phase change (alpha to gamma and reverse).

Disregarding the philosophic difficulties of causes and effects, it is much easier in the course of an investigation to observe certain effects than to uncover underlying causes. However true that may be, it must also be remembered that without causes there would not be any effects.

"Causes," as we understand them at present, imply (1) the appearance of a new phase, (2) possible polymorphic transformation, (3) the separation of even minute amounts of impurities, and, finally, (4) a somewhat broadly used expression "a change in the *nature* of either solvent or solute."

The whole series of alloys, of the compositions listed in Tables I and II were investigated for age hardening. First the alloys were thoroughly homogenized, subsequently reheated to either 788 deg. C., 1065 deg. C., cooled in still air and finally aged at 450 deg. C. and 490 deg. C. for periods up to 425 hr.

Carbonless alloys show a most pronounced and definite tendency to age harden. It will suffice to state that the total increase in hardness for an alloy with 18.20 per cent chromium was, at the end of 425 hours, 19 points on Rockwell "B" scale and the same carbonless alloy with 17.50 per cent chromium showed an increase of 26 points. At the same time, alloys with about 13 and 15 per cent chromium showed much less, in fact, very little tendency to harden.

Similar, almost quantitatively identical, results were obtained on other series of the same alloys, aged under varied conditions. It appears to be quite definitely established that the age hardening property is *directly proportional to chromium concentration*,[2] within the limits studied.

The fact that alloys air-quenched, prior to aging, from 1060 deg. C. show much less susceptibility to age hardening than if quenched from 787 deg. C. becomes quite significant in the light of already discussed dilatometric work. If, as it was suggested, some gamma iron is formed in alloys with 17.50 and 18.20 per cent chromium, upon heating to high temperature, air cooling of the sample will cause some gamma to forego its complete transformation with consequent increase in initial hardness. Aging would tend to decrease the hardness of this gamma, thus diminishing the total effect of the age-hardening process.

Additional data on susceptibility to age hardening with accompanying change in resistance to impact is contained in Table III. The experiment was deliberately confined to the alloys

TABLE IV

| Sample | Temp. Deg. C. | Y. P. Lb. per In.[2] | U. S. Lb. per In.[2] | Per Cent Elongation in 2 In. | Per Cent Reduction Area | Impact Ft. Lb. |
|---|---|---|---|---|---|---|
| 68 | —70 | 43,300 | 78,700 | 37 | .. | 2.5 |
| 68 | 26 | 34,500 | 65,500 | 35 | 70 | 120.0+ |
| 69 | —70 | 96,500? | 98,700 | 34 | 71 | ... |
| 69 | 26 | 49,400 | 82,500 | 28 | 73 | 98.0 |
| 70 | —70 | 69,000 | 105,200 | 33 | .. | 17.0 |
| 70 | 26 | ..... | 88,000 | 33 | 70 | 85.0 |
| 71 | —70 | 52,700 | 79,800 | 36 | 70 | 2.0 |
| 71 | 26 | 34,500 | 64,700 | 34 | 74 | 65.0 |
| 72 | —70 | 48,000 | 87,400 | 38 | .. | ... |
| 72 | 26 | 39,400 | 73,000 | 32 | 72 | 42.0 |
| 73 | —70 | 56,600 | 92,500 | 32 | 66 | ... |
| 73 | 26 | 47,500 | 81,500 | 29 | 67 | 37.0 |
| 74 | —70 | 63,400 | 95,800 | 34 | .. | 3.0 |
| 74 | 26 | 46,200 | 81,300 | 27 | 67 | 18.0 |
| 75 | —70 | 48,800 | 75,400 | 15* | 13 | 2.0 |
| 75 | 26 | 45,800 | 64,500 | 31 | 69 | 30.0 |
| 76 | —70 | 61,600 | 90,600 | 33 | 63 | ... |
| 76 | 26 | 44,400 | 78,600 | 29 | 66 | 10.0 |
| 77 | —70 | 59,000 | 94,300 | 15* | 13 | ... |
| 77 | 26 | 45,500 | 79,700 | 26 | 68 | 6.0 |
| 77 | 26 | 44,800 | 79,300 | 29 | 68 | .. |
| 78 | —70 | 85,100 | 98,800 | 28 | .. | 1.5 |
| 78 | —70 | 68,400 | 101,000 | 29 | 60 | 1.5 |
| 78 | 26 | 49,700 | 83,200 | 28 | 67 | 9.0 |
| 79 | —70 | 67,400 | 83,800 | 23 | .. | 2.0 |
| 79 | 26 | 42,800 | 67,400 | 29 | 68 | 5.0 |
| 80 | —70 | 60,100 | 90,100 | 33 | 63 | ... |
| 80 | 28 | 49,500 | 74,600 | 28 | 70 | 4.0 |

*Broke in threads.

[2] This *definite* proportionality between the degree of age hardening and chromium content disposes, quite decisively, of the remote, but nevertheless realized, possibility that aging might have been caused by the impurities present in the alloys.

made in the orthodox way. The loss of resistance to impact in the alloys between 16 and 19 per cent chromium with 0.02 per cent carbon is quite astounding.

I admit that it was with deliberation when I spoke just a few minutes ago, of observed effects and the difficulties in uncovering underlying causes. The aging of chromium alloys is an effect. You will probably agree with me that the explanation is neither simple nor obvious. The questions to which I should like to have a definite answer would be (a) what is the actual process of age hardening in iron-chromium alloys and (b) is it a true case of precipitation hardening and if so what is the precipitated constituent?

Assumption of the existence of the compound FeCr within certain limits of concentration suggests an explanation, admittedly speculative, of age hardening. Is it not possible that with much prolonged time of heating (approach to equilibrium) the limits of compound formation may be found to extend far beyond those sketched by previous investigators?

The indisputable proof would have been forthcoming if it could be shown that the samples of 16 to 20 per cent chromium aged for 425 hr. (or approximately 18 days) contained the compound FeCr in equilibrium with iron-chromium solid solution.

By means of X-rays several alloys were investigated. No new lines appeared in the aged samples and their photograms were identical with those for unaged samples. The lines in the aged samples were found to be somewhat more diffuse, but the difference was not sufficient to be considered as significant. The measurements of the lattice parameter before and after aging were found to be unchanged, making allowances for experimental error.

The results of microscopic examination were equally negative. Although the aged samples appeared to be reacting toward etching reagents somewhat differently and, at times an anxious eye believed that it was seeing small agglomerations of precipitate, especially at grain boundaries or slip planes, the hoped for and conclusive evidence was not found. Of course, it is not altogether surprising. In the first place, the aging phenomenon is not necessarily caused or accompanied by precipitation in the ordinary sense—a well known example being duralumin. Dr. Merica has cautioned that "age hardening may also occur in consequence of some structural alteration other than that of the precipitation of excess solute."

But even if we *assume*, at present we would not be justified to use any other word, that age hardening of chromium-iron alloys is caused by *actual precipitation* of a constituent —the amount and the degree of agglomeration must be considerable before it would be detected either by microscope or by X-rays.

TABLE V

| Alloy No. | Composition Cr Per Cent | Composition C Per Cent | Impact Resistance in Foot Pounds: Broken at 30 Deg. C. | Heated to 92 Deg. C., Broken at 92 Deg. C. | Heated to 92 Deg. C., Held 3 Hr., Cooled Broken at 30 Deg. C. | Refrigerated to —78 Deg. C. and Broken | Refrigerated to —78 Deg. C. Broken at 30 Deg. C. |
|---|---|---|---|---|---|---|---|
| F12 | 11.82 | 0.010 | 120.0 | .... | ... | 2.5 | 182.0 |
| W14 | 12.96 | 0.008 | 130.0 | .... | ... | 3.0 | 132.0 |
| W16 | 14.95 | 0.008 | 88.0 | .... | .. | 5.0 | 74.0 |
| F18 | 17.50 | 0.010 | 8.5 | 234.0 | 12.0 | .. | .... |
| F20 | 18.20 | 0.012 | 8.0 | 135.0 | 7.0 | .. | .... |

## Impact at Low Temperature Studied

The impact brittleness of some metals at sub-zero temperatures, definitely known to be independent of any phase change, is well known. The analogy between this phenomenon and the behavior of iron-chromium alloys appeared to be rather striking. Additional experimental work was thought to be justifiable and to it we will now turn our attention. It was merely hoped to collect further data pertaining to the system under discussion, and, thus, further point out the complexity of the subject and the necessity for additional work in this field.

In executing this part of the investigation, alloys as listed in Tables I and II were tested for impact at *several* temperatures between 76 deg. C. and 90 deg. C., while tensile properties were ascertained only at two temperatures, namely 76 deg. C. and 30 deg. C. (room). All the tests were made *at temperature*. The results are summarized in Table IV.

The ductility *in tension is not* adversely affected by refrigeration to —76 deg. C. In fact, in the majority of cases it is slightly improved, in spite of noticeably increased tensile strength (the latter observation is general for all alloys). But the ductility as measured by *impact* varies within unexpectedly wide limits, regardless, it seems, of carbon content and of previous heat treatment.

More specifically, the following observations concerning impact properties are justified by the evidence: At —76 deg. C. *all of the alloys* are exceedingly brittle. At room temperature (30 deg. C.) sharp demarcation between ductility and brittleness occurs somewhere between 16.75 and 18 per cent chromium. At 50 deg. C. carbonless alloys remain practically unchanged, but those containing carbon and with 33 per cent chromium is hopelessly brittle. In other words, the higher is the chromium content the higher is the temperature at which ductility is regained.

These observations, it will be agreed, parallel those of iron, providing that it is ascertained that no change of physico-chemical nature (polymorphic modification, appearance of a new phase) has taken place at low temperatures: Accordingly, alloys were immersed in a liquid at —78 deg. C., held for ½ hr. (time sufficient to produce brittleness if tested at this temperature), removed, and broken next day at room (30 deg. C.) temperature. The results are shown in Table V.

The reversibility of impact "brittleness" and impact "toughness" (ductility) with the temperature of test obviously excludes the possibility of a permanent change in the alloy at least within the periods used for either refrigeration or treatment in boiling water. It would be exceedingly interesting to ascertain the influence of much longer holding at subzero or slightly elevated temperatures on the properties of alloys.[3] But this would constitute another problem.

Wherein, then lies the explanation for the observed intricate behavior of chromium-iron alloys? Any metal or alloy yields to stresses through cleavage, slip, and twinning. It should therefore be suggested that the resistance of any metal or alloy to rupture is determined by its characteristic cohesive strength (ideal resistance to cleavage) and its resistance to slip (shear). The relative efficiency of these resistances determines the alloy's properties, that is either toughness or brittleness. With the *changing* temperature of test, the relative values for the two mentioned resistances do not remain the same. This is, of course an explanation well known to those who have studied this particular subject. Extending this reasoning to the properties of iron-chromium alloys at room temperature

[3] Will the temperature of boiling water induce precipitation hardening?

TABLE VI

| Alloy Composition Cr Per Cent | $N_2$ Per Cent | C Per Cent | Treatment | Modified Charpy, Ft.-Lb. |
|---|---|---|---|---|
| 17.84 | 0.207 | 0.01 | Normalized from 1650 deg. F. | 3–4 |
| | | | Annealed at 1400 deg. F., air-cooled | 15.0 |
| | | | Very carefully annealed, slowly cooled | 72.0 |
| 18.26 | 0.145 | 0.006 | Normalized from 1650 deg. F | 120.0 |
| | | | Quencher in oil and drawn at 1400 deg. F. | 113.0 |
| | | | Annealed at 1400 deg. F., and air-cooled | 83.0 |

it may perhaps be suggested that changing chemical composition in the series of binary alloys produces the same effect as the described influence of the temperature of test. An interesting observation pertinent to the discussion is found in examining break structures. The structure at the break of alloy W-16 (chromium 14.95 per cent, carbon 0.008 per cent) shows wavy appearance of the strain lines. The same alloy broken at —78 deg. C. (5 ft. lb. impact resistance) shows no distortion (slip) at all, even at the very edge of the broken part. Quite similarly, alloys which show either ductility or brittleness at room temperature (depending, as was described, upon their composition) exhibit the same structural characteristics. Would it be far too speculative to suggest—as a possible explanation —the dependence of cleavage and slip resistance at room temperature upon the distortion of the parent lattice through introduction of foreign atoms? What would be the effect of the manner of distribution of participating atoms within metallic bodies? All these possibilities should affect the manner of "binding" or "bonding" between atoms — the circumstance previously termed as "the change in the nature of solid solution." But all of them constitute at present terra incognita.

## Gaseous Impurities Examined

Among the impurities in metals and alloys should be listed such gaseous elements as oxygen, and nitrogen. Alloys of iron and chromium, prepared with such infinite pains on the part of my collaborator in experimental work, Mr. Rush Lincoln, contained very small amounts of the above mentioned elements: That they could have an influence upon the phenomena described should be adjudged most unlikely. Thus, instead of attempting to reduce further the impurities—confining this expression to oxygen, hydrogen, and nitrogen, it was decided to study the influence of their increasing amounts. Of these three, nitrogen has recently received some prominence and its study in relation to ferrous alloys was undertaken first. The information revealed by a few preliminary experiments justified continuation of the work. And so, the discussion of impurities is reduced to the discussion of nitrogen in iron-chromium alloys, leaving the question of other gases for some future communication.

While the general subject of gases in iron-carbon steels and non-ferrous metals and alloys has been extensively studied, the interaction between special alloys (including alloy steels) and gases received only scant attention.

It is not unreasonable to anticipate that the tendency of a certain alloy to absorb a gaseous element or to combine with it will be determined to a large extent by the same tendency on the part of the metals making up an alloy. Iron has a notoriously low capacity for absorbing nitrogen: Even at high temperatures and pressures the maximum nitrogen found in iron is from 0.005 to 0.04 per cent (by weight, the latter figure at the melting point.) The figures for hydrogen, according to Sieverts and Martin are also very low, even lower than for nitrogen. Among other metallic elements molybdenum will take up very little hydrogen and virtually no nitrogen, which is also true of cobalt and tungsten. Much difference of opinion exists regarding silicon and the influence of increasing amounts of silicon in iron on its absorbing, or as Martin calls it "occluding," capacity for both nitrogen and hydrogen. The behavior of manganese is also debatable, but this much can be said: It was observed in our laboratories that during the attempt to remelt previously distilled manganese under an atmosphere of non-purified argon, the manganese picked up some nitrogen which was present in small amounts in the argon. The element chromium, however, has an astounding affinity for nitrogen, with the strong probability that a nitride is formed.

Realizing this unusual affinity of iron-chromium alloys for nitrogen, it appeared indeed desirable and important to ascertain the influence of nitrogen on the constitution and properties of the chromium alloys.

Dilatometric observations immediately disclosed a very pronounced influence of nitrogen on the phase relationship in nitrogen-bearing alloys. It will be remembered that alloys of 18 per cent chromium are characterized by continuous, smooth "length-temperature" curves on which the existence of gamma to alpha transformation will be manifested only under special procedure for observations. The typical curve for the similar alloy but with nitrogen proves the existence of a definite, sharply defined transformation, both on heating and cooling.

With smaller percentages of nitrogen the magnitude of the transformation diminishes, but the temperature range remains, apparently, unaffected. In other words, addition of nitrogen results in the formation, under equilibrium conditions, of increased amounts of the gamma phase, very much like carbon. In fact, nitrogen appears to be a more powerful factor than carbon: The volume change noted in nitrogen bearing alloy is definitely greater than in the alloy with carbon in similar amount. This conclusion was fully substantiated later by microscopic observations. Similarly with carbon alloys, the transformation in nitrogen containing alloys can be made to occur at any temperature between 200 deg. and 800 deg. C., depending on the rate of cooling. And, as should be expected, the common mechanical properties of the alloys undergo radical changes when such alloys are subjected to the proper heat treatment.

The limited amount of material on hand precluded an exhaustive study of mechanical properties, although it was possible to determine impact toughness in two important alloys. By controlling the nitrogen content and with proper heat treatment, impact characteristics, far above those obtainable in alloys without nitrogen, can be easily secured. An illustrative summary will be found in Table VI.

## A Failure of Stainless Steel

STAINLESS steels do not always meet the expectations of some applications rather hastily installed without very careful investigation. According to reliable reports, piping of stainless steel has been used in some large vessels for pump lines which handle sea water. These pipes have proved a failure, not so much from the corrosion standpoint as from the fact that they filled up with marine growths.

The pipe is being displaced with a material containing copper, such as copper steel, monel metal and so on. The advantages of this material consist in the fact that enough copper is soluble in the sea water so that the marine growth is poisoned and does not deposit itself on inside of pipe. Thus a clean interior is assured.

# Steels for Die-

By SAM TOUR, Vice-president,

HEAT checks in steel are the source of trouble in many industries besides that of die casting. Every shop where metals are subjected to hot working is searching for improvement and hoping for a cure. The development of a material of sufficient strength to be used as a die and yet devoid of the property of heat checking would be a godsend to many shops and many industries.

The need for thorough study and research on the subject is evidenced by the wide variety of hot-working die steels on the market. It is peculiar, but true, that in practically every case the maker of the steel can give concrete evidence to prove his contention that his type of hot-working die steel is as good as or better than any other. A number of steel companies have several hot-working die steels from which choice can be made to fit a particular set of requirements.

Possibly to expect one material to be universally the best hot-working die steel is unreasonable. In some hot-working operations, as in drop forging, the die must have great toughness to withstand the stresses developed; in other operations, as in hot piercing or punching, resistance to erosion at high temperatures, possibly defined as strength and hardness at elevated temperatures, is required. In still others, as in die casting, only sufficient hardness to resist scoring between moving surfaces is required, whereas the resistance to sudden changes in temperature must be at a maximum.

### Formation of Heat Checks

Heat checks, in the writer's opinion, are due to strains set up by repeated changes in temperature, and these strains, at some time or other, set up stresses that exceed the elastic limit or fatigue limit of the material in question. The amount of strain is a function of the difference in temperatures between two adjacent parts of the same block of steel; in other words, the temperature gradient. Assuming that the modulus of elasticity of steel is approximately independent of composition, the following properties should be sought for in the effort to obtain a steel with maximum resistance to heat checking: (1) minimum coefficient of expansion; (2) maximum thermal conductivity; (3) maximum elastic limit; (4) maximum endurance limit.

If we consider that the stresses are developed rapidly by sudden heating, we must also bear in mind that the application of stress has somewhat the nature of an impact and we must, therefore, add a high impact value to the list of the desirable qualities of a die steel. In most cases the die, during operation, becomes hot. We must, therefore, consider all of these properties from the standpoint of this temperature. In other words, the desired high elastic limit and the desired high impact strength, etc., should be at the elevated temperatures.

Daeves found that a steel containing 13 per cent Cr, 0.5 per cent Ni, 0.7 to 1.00 per cent C has a coefficient of expansion less than that of ordinary alloy steels such as studied by Mathews, but Daeves also found this steel to have a lower heat conductivity than carbon steels.

Mathews found that for the ordinary types of alloy steels in the heat-treated condition and in the ranges as shown there was very little variation in this property.

Langenberg found that heat-treated chromium-vanadium steel has maximum notch-bar impact strengths at temperatures between 200 and 500 deg. F. At 1000 deg. F., the highest temperature he investigated, the chromium-vanadium steel was considerably weaker than between 200 and 500 deg. F. He found nickel-chromium steel to have maximum impact strength between 200 and 750 deg. F., its strength apparently holding over a greater range. Of all the steels that he tested the nickel-chromium steel of composition as follows seemed to be the best in this respect: C, 0.39 per cent; Mn, 0.46; P, 0.03; S, 0.025; Si, 0.22; Ni, 3.44; Cr, 1.58.

Moore, Komers and Jasper in their studies of the fatigue of metals, arrive at the conclusion that for ferrous metals at least the endurance limit furnishes the best criterion of resistance to repeated stress with the ultimate tensile strength or the Brinell hardness (which seems to be related to ultimate strength) as a somewhat less reliable index. These investigators call attention to the need of an investigation of the strength of steel under repeated stress and at elevated temperatures.

Work at the General Electric Co. has indicated clearly that there is a relation between the results of notched-bar impact tests and those of notched-bar fatigue tests. Two pieces of steel apparently identical as rated by tensile strength, hardness, elongation, reduction of area and unnotched impact strength may have widely different notched-bar fatigue resistances, and when they do they also have widely different notched-bar impact strengths. The General Electric work shows this on both Izod and Charpy types of impact tests.

### Practical Requirements of a Steel for Die-Casting Dies

From the practical standpoint of the user—the die-casting company—the requirements for a steel for dies for casting aluminum, for example, can be listed as follows:

1. Machinability.
2. Stability in heat treatment.
3. Resistance to heat checking.
4. Resistance to deformation, battering, etc.; i.e., hardness.
5. Resistance to cleavage cracking on sudden heating or cooling; i.e., toughness.
6. Resistance to erosive and solvent action of molten aluminum.
7. Cleanliness and uniformity.
8. Cost—producibility, forgeability, etc.
9. Properties at elevated temperatures.

THE name Sam Tour for more than a decade has been virtually a synonym for die castings. Some years ago, one of the Tour contributions on the subject was a discussion of heat checks or thermal cracks in die-casting dies. In New York, Oct. 3, at a meeting

# Casting Dies

Lucius Pitkin, Inc., New York

held by the American Institute of Mining and Metallurgical Engineers, the same author presented additional observations on the subject and offered suggestions as to methods for further attack of the problem. This latest paper is here reviewed at length.

*Machinability.*—From the standpoint of machinability chrome-vanadium steel seems to be quite satisfactory. Hot-working tungsten steels are much more difficult to machine than the chrome-vanadium steels and are considered just barely passable in the die-casting industry today. Austenitic steels, in general, are out of the question. Possibly the austenitic steels could be made more machinable by the addition of zirconium sulfide, or something of that nature, but it is doubtful whether even if this could be done the steels would be suitable for die-casting dies.

*Stability in Heat Treatment.*—The standard chrome-vanadium steel used for many years for dies is not satisfactory because of its tendency to warp, grow, shrink and crack during the heat-treating process. The tungsten-chromium type of air-hardening die steels are all quite satisfactory from the standpoint of stability in heat treatment. The tungsten-chromium type of oil-hardening die steels are somewhat dangerous, inasmuch as it is common practice in the manufacturing of die-casting dies to have blocks cut up with very heavy sections next to very thin sections, and with sharp corners between the two, and a steel that requires oil quenching is liable to crack at these weak points. In general, it seems as though the air-hardening type of steel, whether it contains tungsten or not, is preferable for general purposes.

*Resistance to Heat Checking.*—The failure by heat checking of die blocks of any one steel seems, to some extent, to be a function of the hardness. In practically all steels tested or used, die life seems to be determined, so far as heat checking is concerned, by the initial hardness. Up to the point where insufficient toughness remains in the steel it seems to be true that the harder the block the longer it will stand up. As the hardness increases there is a gradual and characteristic change in the type or configuration of the heat checks. Hardness, however, is not alone the entire answer, as is indicated by the fact that plain carbon steels of 400 Brinell are inferior to chrome-vanadium steel of the same Brinell hardness. Also, chrome-vanadium steel of 430 Brinell is inferior to chrome-tungsten steel of the same Brinell hardness.

*Hardness.*—Apart from the relation of hardness to resistance to heat checking, there is required a certain amount of hardness in any block, for service reasons. Dies are made up of moving parts, slides, cores, pins, etc., and usually are hot when in operation. All die parts must be hard enough so that excessive rubbing and scoring and eventual seizing of the parts does not occur. It is possible to have soft main or stationary blocks in a die and hardened moving pieces, but it is preferable to have all the main parts of the die made of the same steel and hardened. Moving parts can be left a bit harder than the stationary parts. All blocks should be hard enough to resist defacement or deformation due to the powerful closing action of the machines when stray pieces of metal are accidentally caught somewhere on the parting faces of the die. About 325 Brinell hardness is as low as is permissible for main blocks in this connection. From the standpoint of resistance to heat checking, the minimum hardness is considerably above 325. For example, it has been found that the hot-working die steels of the chrome-tungsten type develop heat checking rapidly at Brinell hardnesses around 325 and at such hardnesses are apparently inferior to chrome-vanadium steel, whereas if the two steels are compared at Brinell hardnesses at 430 the chrome-tungsten steels are superior to chrome-vanadium steels.

*Cleavage Cracking.*—This is a difficulty that is not at all serious in the chrome-vanadium steels except when they are left at a Brinell hardness of above 477. In the chrome-tungsten steels cleavage cracking is a serious problem and does not seem to have much relation to the Brinell hardness of the block of steel, but seems to be more closely associated with its macrostructure. Some chrome-tungsten blocks develop serious cleavage cracks at hardnesses as low at 340 Brinell, whereas others of the same analysis do not develop such cracks even at hardness as high as 477. In most cases where serious cleavages occur in chrome-tungsten steel the fracture shows evidence of a fish-scale or a marble structure. As this structure is usually associated with brittleness, it would seem that cleavage cracking is a function of brittleness. The most promising test for this is the notched-bar impact test, and it seems that a steel of a high impact strength at the hardness at which it is to be used is least subject to cleavage cracking.

*Erosive and Solvent Action of Molten Aluminum.*—Erosion and solvent or soldering action of molten aluminum and its alloys on the die steels is likely to occur at the gates, where the aluminum is at maximum temperature and is made to travel at high velocities across the steel, thus eroding and attacking the steel. A thin oxide layer or an applied layer of graphite prevents this solution attack if the layer can be kept in place and withstand the erosive action of the stream of metal. This erosive action sometimes becomes severe where the molten metal impinges directly upon a steel surface. Resistance of the steel to solvent action is therefore to be preferred although this matter should not be considered of major importance. For years statements have been made that nickel steels are not suitable for dies for aluminum die casting, because of this solvent action. That this is not true is indicated by the promising results obtained by the

writer some years ago on several steels containing up to 5 per cent of nickel. The nature of the surface seems to be more important than the composition of the base.

*Cleanliness and Uniformity.*—Cleanliness and uniformity of a die steel are essential. Segregations and nonmetallic inclusions are starting points for thermal fatigue failures and cleavage cracking. Segregations appearing as hard spots cause great difficulties in die sinking. Internal seams, slits, cracks and other defects must not be encountered at or near the base of a die impression after the greater part of the die sinking has been done. Ample top and bottom discards must be taken from the ingot. Ingots and ingot molds and teeming practice must be regulated to avoid secondary piping, slag inclusions, oxide inclusions, etc. Heating, forging and annealing must eliminate all ingotism and develop uniform structure throughout the section of the finished piece, and must not develop seams, cracks, hammer bursts or other defects.

*Cost.*—The finished steel for dies for aluminum die casting must be producible at a reasonable price not only from the standpoint of cost of ingredients but also from the standpoint of manufacturing costs in connection with melting, pouring, cogging, discards, chipping, annealing, forging, etc. It seems as though the die-casting trade will stand prices up to 40c per pound but not much above that figure, and desires prices considerably below that.

*Properties at Elevated Temperatures.*—In service, dies for casting aluminum are subjected to temperatures from room temperature or lower (cooling-water temperatures) up to 800 or 900 deg. F., or possibly higher. Small uncooled parts, for example, near the gate and almost completely surrounded by the aluminum casting, may conceivably become heated almost to the temperature of the incoming metal. Casting temperatures in die casting of aluminum range from 1125 to 1400 deg. F., with the average temperature possibly in the range from 1200 to 1250 deg. F. It is, of course, conceivable that in many cases the surface layers of the die steel, before the body of the blocks of steel can conduct the heat away, become heated to a red heat. For this reason, therefore, red hardness seems to be a desirable property for a die-casting die steel. It is also important that the steel maintain a relatively high elastic limit and impact strength at these elevated temperatures. In other words, the elastic limit and impact-strength curves should preferably have no low areas or inverse deflections from room temperature up to say, 1000 deg. F.

TABLE 1.—RESULTS OF TENSILE TESTS

| Steel | Original Area, Sq. In. | Yield Point, Lb. | Maximum Load, Lb. | Yield Point, Lb. per Sq. In. | Tensile Strength, Lb. per Sq. In. | Elongation In. | Elongation Per Cent | Reduction of Area, Per Cent | Brinell Hardness | Fracture |
|---|---|---|---|---|---|---|---|---|---|---|
| 527 | 0.2003 | 52,700 | 55,720 | 263,100 | 278,200 | 0.16 | 8.0 | 19.2 | 512 | Fine granular with silky lip. |
| 528 | 0.2003 | 51,800 | 55,280 | 258,600 | 276,000 | 0.24 | 12.0 | 41.9 | 532 | Silky ½ cup. |
| 531 | 0.2003 | 47,860 | 49,480 | 238,930 | 247,000 | 0.28 | 14.0 | 44.9 | 477 | Silky ½ cup. |
| 532 | 0.2003 | 52,500 | 56,030 | 262,100 | 279,700 | 0.07 | 3.5 | 5.1 | 532 | Fine granular with silky lip. |
| 533 | 0.2003 | 49,100 | 51,640 | 245,100 | 257,800 | 0.20 | 10.0 | 30.9 | 512 | Fine granular with silky lip. |

## Testing Die Steels in Die-Casting Plants

In plants where the center-gate die-casting machine is used there is a standard part known as the gate former or gate bushing. In these plants often new die steels are tested by making up a few gate formers. The writer has tried out many different kinds of proposed die steel in this way.

Another method of testing a proposed new steel is to insert a block of it in a die. This is common practice in plants that use the split-gate type of machine, which has no gate former. The difficulty in this type of testing is that when a special block is inserted in a given die it is necessary to wait until the die-casting company's customer who owns the die orders a sufficient number of castings to show the actual service the steel will render. This often takes years, and sometimes can never be accomplished because the customer changes his design or his source of supply or discontinues the part.

Another common practice is to use the new steel in the form of a sprue cutter or splitter pin. This is the gate post in many dies on the center-gate machine, and takes the full force of the incoming metal. In most cases, these splitter pins are not very carefully machined, are not held to close dimensions because they do not form a part of the finished casting, are not water-cooled, and are not given close attention. In general, it is difficult to obtain any important information in tests of sprue cutters, except from the standpoint of the soldering action of the aluminum on the proposed die steel. Even this is sometimes at fault because often it is desirable to have the metal stick to the sprue cutters to some extent, and no effort is made to keep the sprue cutter coated with graphite and oil to prevent the solvent action. If the sprue cutter were a part of the die, the attention given it would be entirely different, and possibly the net result on the steel would differ considerably.

A method of testing sometimes used is known as "total immersion." A block, for instance a 2-in. cube, of the proposed die steel is dropped into a molten bath of aluminum together with a similar block of a known steel and allowed to remain in the molten aluminum for a number of days. When it is taken out the aluminum is cleaned off as well as possible and the weight losses are determined. This is truly a solvent action test and therefore is not indicative of what the steel might do in resisting heat checking. It is well known that cast iron is much less soluble than steel in molten aluminum; therefore, although cast iron is not a suitable material for die-casting dies for aluminum, it stands up much better than any of the standard die steels in this total immersion test. It is interesting to note, however, that one or two special steels have seemed to stand up better in aluminum dies than chrome-vanadium, and also to have less tendency to go into solution in molten aluminum in this total immersion test than chrome-vanadium steel. It is the writer's belief, however, that these results are not important and that normally the total immersion test is not of much value in evaluating different proposed die steels.

A proposed method for testing new die steels might be termed the "alternate immersion method" with water cooling. In this test the samples of die steel are mounted on a crank arm so as to be alternately dipped into and taken out of a bath of molten alumi-

num eight or ten times per minute. The specimens are drilled so that water may be circulated through them to maintain them at a fairly low temperature. A counter on the crank arm makes it possible to determine the total number of cycles gone through until the time that heat checking begins to appear. Ten or twelve different steels can be tested at once in this manner. The test is not a duplication of the conditions in a die-casting die, because the molten metal does not strike the specimens as suddenly and the contact between the molten metal and the steel is not as intimate as when the molten metal is forced against the steel under considerable pressure and with considerable velocity.

## Laboratory Testing

A die-casting company wants to know a number of things about a new steel before putting it to a test in service. This information should be supplied by the mill proposing the steel, and can be determined by laboratory methods of testing somewhat as follows:

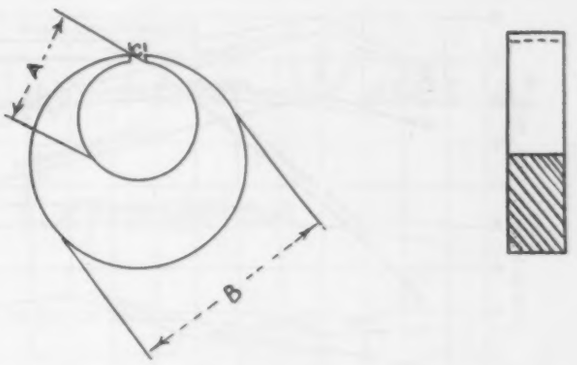
The various transformations occurring in the steel upon heating and cooling are first to be determined, which can be done easily by the use of a Rockwell dilatometer furnace. From the transformations on heating and cooling as shown by the dilatometer curves the proper heat-treatment temperatures for the proposed steel can be selected. From a heat-treating standpoint, it is desirable next to know whether or not small and large pieces of the steel will heat-treat at the same temperature or whether higher temperatures will be required for the large pieces. In other words, the depth of hardening of the steel is to be determined, and this usually is done by the heat treatment of a small piece and a large piece simultaneously and checking up the finished hardness of the pieces. In this, of course, it is to be remembered that small pieces do not have to be soaked at temperature as long as the large pieces, but the actual temperature should be the same irrespective of the size of the piece.

The next thing to determine is the amount of dimensional change occurring in the steel as a result of various heat treatments. This can be carried out by the actual heat-treating of U-shaped blocks of steel. Such blocks of steel as machined up are carefully measured, then given the quenching treatment as determined by the previous test; again carefully measured, then drawn and again measured; completely annealed and again measured, then rehardened and again measured, and, finally, drawn again and measured.

Other laboratory tests to be carried out are Brinell hardness, tensile strength and elastic limit, and notched-bar impact tests at room temperature and at 200, 350, 500, 650 and 800 deg. F.

Finally the proposed steel should be examined metallographically to see that it is clean, free from nonmetallic inclusion and uniformly free from serious segregation; also, to see that it has a uniform grain structure, free from abnormally large grains, outstanding grain boundaries, and so forth.

**Table 2—Results of Movement Tests**




| Heat-Treated Condition | | Normalized | Hardened | Drawn | Variation |
|---|---|---|---|---|---|
| No. 527 | A | 2.8992 | 2.9000+ | 2.9030+ | +0.0038 |
| | B | 4.9957 | 4.9975+ | 4.9995+ | +0.0038 |
| | C | 0.5020 | 0.5195+ | 0.5200+ | +0.0180 |
| No. 528 | A | 2.9031 | 2.9022— | 2.9042+ | +0.0011 |
| | B | 4.9930 | 4.9905— | 4.9933+ | +0.0003 |
| | C | 0.5018 | 0.5070+ | 0.5085+ | +0.0067 |
| No. 531 | A | 2.9114 | 2.9032— | 2.9044+ | —0.0070 |
| | B | 5.0082 | 5.0023— | 5.0032+ | —0.0050 |
| | C | 0.5180 | 0.5115— | 0.5120+ | —0.0060 |
| No. 532 | A | 2.8995 | 2.8975— | 2.8980+ | —0.0015 |
| | B | 4.9971 | 4.9981+ | 4.9997+ | +0.0026 |
| | C | 0.5021 | 0.5014— | 0.5012— | —0.0009 |
| No. 533 | A | 2.9003 | 2.8984— | 2.8980+ | —0.0023 |
| | B | 5.0025 | 5.0037+ | 5.0027— | +0.0002 |
| | C | 0.5022 | 0.5000— | 0.5005+ | —0.0017 |

## Tests of New Compositions

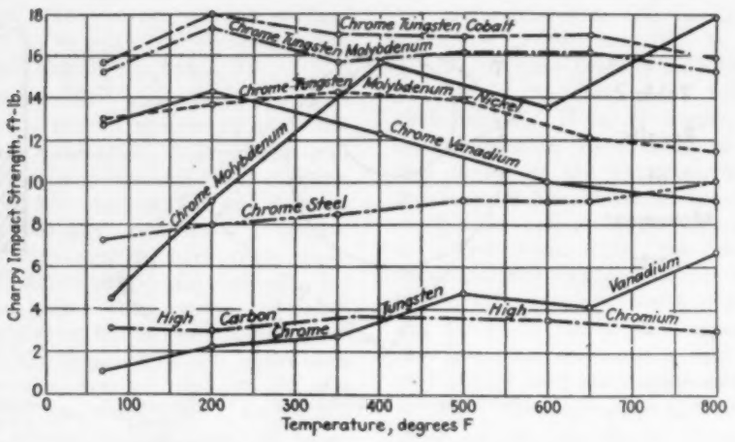
In cooperation with the Vanadium Alloy Steel Co. a number of proposed compositions were studied. Steels of five different analyses were melted and forged into 4-in. cubes. All steels after forging were annealed by sealing in a tube and cooling slowly from 1575 deg. F. Decarburized surfaces were then removed by machining and the blocks heat-treated by cooling in still air from 1900 deg. F. The blocks were then compared for the degree of scale present.

The No. 527 steel was found to possess a thin scale, which was very adherent and difficult to remove. Steel No. 528 had a heavy, adherent scale, which also was hard to remove. No. 531 had a thin adherent scale less in amount than that observed on the No. 527 steel and easier to remove. Steel 532 possessed a heavy adherent scale difficult to remove, while steel 533 had a heavy scale, which was loosely adherent and easy to remove. It was apparent that steel 531 possessed the best properties in this regard.

Brinell tests were taken to observe the hardening properties of the various steels, and these results, together with the compositions of the metals, are here tabulated. Hardness tests after drawing to 1075 deg. F. are also indicated.

Forgings for movement and tensile tests were made from the five blocks used for hardness tests, the forgings for movement tests being finished to 5⅛ in. round by 1⅛ in. thick and forgings for tensile test specimens to ⅞ in. square by 14 in. long. All forgings were then annealed at 1575 deg. F.

The tensile test specimens were matched to 0.512 in. in order to allow for movement and removal of surface after heat treatment. They were then heated to 1900 deg. F., air-cooled and drawn for 1 hr. at 1075 deg. F. After this treatment they were cleaned up and finished to 0.505 in.




Impact tests of steels for die-casting dies at elevated temperatures.

The results of the tensile tests are shown in Table 1.

The movement test specimens were normalized in pitch coke at 1250 deg. F. before any measurements were taken. They were then measured; hardened by packing in pitch coke and heating to 1900 deg. F., then cooled in still air. After remeasuring they were drawn at 1075 deg. F. and again measured. The results of these tests are given in Table 2.

## Impact Strengths at Elevated Temperatures

As already mentioned, die-casting dies are subjected to sudden stresses due to local and sudden heating. In service, die-casting dies for aluminum operate at temperatures varying from cold up to as high as 800 deg. or 900 deg. F., or possibly higher. Die steels fail by developing large cracks or fine heat checks. Failures are accentuated by the presence of surface imperfections, such as scratches, indicating that the notch effect must be taken into consideration. It would appear, therefore, that a good steel for dies for casting aluminum should have a relatively high impact strength at elevated temperatures, and that there should be no low areas in the impact-strength temperature curve for the range from room temperature up to 800 deg. or 1000 deg. F.

Of the number of different steels made up experimentally by the Vanadium-Alloys Steel Co., two steels, Nos. 528 and 531, seemed most promising from the results of the heat-treating, scaling and dimensional change tests. Therefore Charpy impact - strength temperature curves were plotted for these two steels.

Fifteen to 18 Charpy impact-test specimens in the machined and heat-treated condition were supplied by the Vanadium-Alloys Steel Co. for each of the steels 528 and 531, for a chrome-vanadium steel and for No. 527 steel. Additional sets of Charpy impact-test specimens in the machined and heat-treated condition were supplied by the Hoover Co. for each of two additional steels.

Testing was carried out on an Amsler impact-testing machine of the Charpy type with a pendulum with a delivering capacity of approximately 120 ft.-lb. of energy. One-half of each of the broken specimens was carefully tested for Rockwell hardness. Tests were made by the Hoover Co. on two more steels and their results are included in this paper. All results and analyses are here shown.

The average Rockwell hardness of the No. 527 specimens was slightly lower than that of the No. 528 and No. 531 specimens. Also, the 531 specimens were slightly harder than the 528 specimens. It is significant that the impact strengths are lower for the material having higher Rockwell hardness. The considerably lower impact strength, however, for steel No. 531 as compared to No. 528 seems to be more than could be accounted for by the slight variation in Rockwell hardness. The fact that the impact - strength decreases continuously from a temperature of 350 deg. in steel No. 531 seems to be significant also as compared to steel No. 528. In general, it might be concluded that so far as impact strength temperature is concerned steel 528 is the equal of steel 527.

The chrome-molybdenum and the chrome-vanadium alloy steels have the greatest variation in impact strengths, the latter having its maximum strength of 14.33 ft.-lb. at 200 deg. F. and falling off consistently to its minimum of 9.17 ft.-lb. at 800 deg. F. The chrome-molybdenum shows a decided increase in impact-strength from room temperature to 400 deg. F., but at 600 deg. F. the impact-strength has fallen off appreciably.

The chrome - tungsten - vanadium steel showed abnormally low impact-strengths throughout, which may be attributed to some treatments of the steel prior to the making of the impact-test bars in which some fish-scale or marble structure had developed. This type of steel oil-quenched, not air-hardened, from 2100 deg. F. and drawn is often used rather successfully for a hot-working die steel.

The high-carbon, high-chrome steel also showed abnormally low impact-strengths throughout. This steel oil-quenched from a lower temperature would probably have yielded higher-impact strengths.

TABLE 3—COMPOSITION OF VARIOUS DIE STEELS

| | Chrome-Vanadium | Chrome-Tungsten-Molybdenum (528) | Chrome-Tungsten-Molybdenum-Nickel (531) | Chrome-Tungsten-Cobalt (527) | Chrome-Tungsten-Vanadium | Chrome | Chrome-Molybdenum | High-Carbon, High-Chrome |
|---|---|---|---|---|---|---|---|---|
| Hardness, Rockwell C.. | 48.0 | 46.5 | 47.4 | 45.7 | 47.0 | 46.5 | 45–47 | 46.0 |
| Composition: | | | | | | | | |
| Carbon ..... | 0.46 | 0.28 | 0.33 | 0.34 | 0.32 | 0.90 | 0.50 | 1.50 |
| Manganese ... | 0.65 | ... | ... | 0.33 | 0.28 | 0.34 | 0.65 | 0.29 |
| Phosphorus .. | 0.013 | ... | ... | 0.018 | 0.019 | 0.011 | ... | ... |
| Sulfur ..... | 0.022 | ... | 0.049 | 0.026 | 0.023 | 0.014 | ... | ... |
| Silicon ..... | 0.34 | 1.27 | ... | 0.96 | 0.51 | 0.22 | ... | 0.34 |
| Nickel ..... | ... | ... | 1.45 | ... | ... | ... | ... | ... |
| Chromium ... | 2.65 | 4.77 | 4.53 | 5.11 | 3.23 | 3.45 | 0.70 | 12.00 |
| Tungsten .... | ... | 1.01 | 1.15 | 5.36 | 9.24 | ... | ... | ... |
| Molybdenum .. | ... | 1.50 | 1.06 | ... | ... | ... | 0.35 | 1.00 |
| Vanadium .... | 0.20 | ... | ... | ... | 0.47 | ... | ... | 0.75 |
| Cobalt ..... | ... | ... | ... | 0.50 | ... | ... | ... | ... |

# American Industries Display Their Wares at National Metal Exposition

ONE of the most entertaining industrial exhibitions of recent years closed its doors last Friday after a five-day session. Registered attendance exceeded 15,000 and well over 30,000 visitors witnessed a glittering array of exhibits pertinent to the production, fabrication, welding, inspection and application of ferrous and non-ferrous metals. Over 160 separate booths were scattered over some four acres of floor space in Commerce Hall of the Port of New York Authority Building. The rented floor space surpassed by 40 per cent that of the Detroit exposition last year, thereby indicating to some extent that the trend of industrial sentiment is upward.

The dominant theme of the show was alloy steel—its multifold advantages in either cast or rolled form and its constantly expanding usage in consumer products. Stainless steel was in particular evidence in the form of murals, statues, etchings, and panelwork. Of the many booths of interest, seventeen selected at random are displayed on the following pages.

On the inside page there is reproduced a general view of the sixteenth annual dinner of the American Society for Metals, which was held in the Hotel Pennsylvania, Thursday, Oct. 4. The principal speaker was Republic Steel's president and board chairman, T. M. Girdler, who can be seen near the center of the speakers' platform. Near Mr. Girdler is Dr. Albert Sauveur, Gordan McKay Professor of Mining and Metallurgy at Harvard University, who was awarded the society's newly established Albert Sauveur Achievement Medal. In addition, John Chipman, of the University of Michigan, was announced as the winner of the Henry Marion Howe Medal, conferred annually on the author of the paper of highest merit published by the society. W. B. Coleman, of Philadelphia, was given the President's Medal as past-president of the society. W. H. Phillips, of Pittsburgh, the outgoing president, presided.

*Photos by Drucker & Baltes Co.*

TABLE II

| Heat No. | Analysis, Weight Per Cent C | Mn | Si | P | S | Cr | Ni |
|---|---|---|---|---|---|---|---|
| 68 | 0.030 to 0.030 | 0.39 | 0.20 | 0.011 | 0.013 | 14.28 | 0.10 |
| 69 | 0.098 to 0.104 | 0.28 | 0.31 | 0.013 | 0.010 | 14.63 | 0.10 |
| 70 | 0.194 to 0.196 | 0.35 | 0.30 | 0.010 | 0.013 | 14.74 | 0.11 |
| 71 | 0.023 to 0.025 | 0.35 | 0.27 | 0.010 | 0.014 | 16.66 | 0.10 |
| 72 | 0.103 to 0.104 | 0.35 | 0.29 | 0.011 | 0.011 | 16.84 | 0.12 |
| 73 | 0.147 to 0.148 | 0.31 | 0.26 | 0.012 | 0.015 | 16.56 | 0.14 |
| 74 | 0.191 to 0.191 | 0.35 | 0.29 | 0.006 | 0.013 | 16.74 | 0.14 |
| 75 | 0.021 to 0.023 | 0.37 | 0.32 | 0.008 | 0.013 | 18.84 | 0.13 |
| 76 | 0.102 to 0.103 | 0.36 | 0.27 | 0.010 | 0.008 | 18.84 | 0.17 |
| 77 | 0.155 to 0.158 | 0.34 | 0.32 | 0.011 | 0.010 | 18.55 | 0.14 |
| 78 | 0.202 to 0.207 | 0.36 | 0.30 | 0.010 | 0.014 | 18.77 | 0.16 |
| 79 | 0.028 to 0.032 | 0.35 | 0.25 | 0.010 | 0.012 | 20.61 | 0.15 |
| 80 | 0.078 to 0.082 | 0.35 | 0.34 | 0.011 | 0.009 | 20.68 | 0.18 |

idea in mind. Impact resistance and hardness (from among mechanical properties), dilatometric observations, microscopic examination and X-rays were selected to ascertain the characteristics; age-hardening, followed by microscopic and X-ray study, mechanical characteristics at subnormal and slightly elevated temperatures were then ascertained in an attempt to answer the question *how*.

## Toughness Disappears Also in "Carbonless" Alloys

Alloys on which impact values were obtained were heat treated in several ways thought to be the best for the purposes of investigation. In each case the relative *trend* was quite the same.

It was found that the abrupt disappearance of toughness is just as evident in "carbonless" as in alloys fairly high in carbon. Furthermore, the loss of toughness is not, so far as could be ascertained, gradual, but asserts itself within a very narrow range of chromium concentration, which is substantially the same for all alloys, irrespective of their carbon content.

From these observations it was concluded that purity and, specifically, carbon, play no part in the sudden change of toughness.[1] The explanation should be sought either in some radical change in the constitution of the alloys or in some other factor as yet undiscovered.

Ordinarily an abrupt change in one mechanical property indicates similar, but not necessarily of the same sign, changes in others. Concurrent loss of ductility and gain of hardness in most of the steels is a well-known illustration. It does not apply, however, to alloys of chromium. In both the very low and the (fairly) high carbon series the change in hardness (with increasing chromium) is gradual and relatively small. Other mechanical properties will be found to vary much in the same manner as hardness (if care is taken to give the alloys proper heat treatment). See Table IV.

As is known, grain size is controllable and also measurable. In these vacuum melted carbonless alloys of chromium the grains are remarkably large. To break up these grains is no easy matter, but can be accomplished by repeated mechanical working. The fact that the sudden drop in toughness is independent of grain size was clearly demonstrated by testing two alloys with grains averaging respectively 0.2 and 4.0 square millimeters. The results of the tests were, for all practical purposes, identical.

There is no relation, for the same carbon content groups, between impact strength and grain size. These results must not be, however, misunderstood. We are discussing the abrupt appearance of impact brittleness, and its independence of the grain size. In a given alloy, if it contains less than a certain, critical amount of chromium, the resistance to impact (and, of course, other properties) may be considerably improved by grain refinement, as should be expected. But in alloys, in which the impact brittleness appears to be an inherent characteristic, the grain size alone is of no consequence.

[1] It is not to be inferred from this statement that carbon has no influence at all. It has definite influence in those alloys which lie to the left of that "critical" concentration of chromium where toughness vanishes.

TABLE III

| Sample No. | Analysis C Per Cent | Cr Per Cent | Impact, Foot Pounds Heated to 1450 Deg. F. for 3 Hr., Air Cooled | Heated to 1450 Deg. F. for 3 Hr., Aged at 914 Deg. F. for 200 Hr. |
|---|---|---|---|---|
| 68 | 0.03 | 14.28 | 175 | 129 |
| 70 | 0.19 | 14.74 | 34 | 62 |
| 71 | 0.02 | 16.66 | 132 | 4 |
| 74 | 0.19 | 16.74 | 44 | 25 |
| 75 | 0.02 | 18.84 | 85 | 2 |
| 76 | 0.10 | 18.84 | 73 | 3 |
| 78 | 0.20 | 18.77 | 12 | 3 |
| 79 | 0.03 | 20.61 | 11 | 2 |
| 80 | 0.08 | 20.68 | 7 | 2 |

## Lattice Parameters Are Checked

In view of the careful X-ray work, reported in previous investigations, the efforts of our laboratory were confined to checking lattice parameters of one or two alloys. When it was found that our measurements checked those of Preston, further work along this line was discontinued.

Microscopic examination revealed the typical structure of solid solutions, with, apparently, no visible change whatsoever as we pass from tough to brittle alloys. One observation is worthy of note: Distortion, such as that resulting from cold work of ferrite and ferrite bearing steels, is revealed on a polished section by the presence of characteristic wavy strain lines. In the alloys under investigation, strain lines are altogether different. They are straight, comparatively few in number, and oftentimes intersect each other at different angles, (similar to Fe-Si alloys).

The proof of the phase change occurring in the alloy with 12.99 per cent chromium is given by the noted failure of heating and cooling curves to follow the same course, although at the end of the experiment the sample comes to its original dimensions. In alloys of 15, 17.5, and 18.2 per cent chromium, however, the path and the slope of the cooling and heating curves are identical. Thus, we may conclude that the end of the gamma loop lies somewhere between 13 and 15 per cent chromium, as generally accepted.

Recent unpublished investigations of chromium steels reveals that the rates of transformation in these steels are very low, especially if the transformation does not involve the formation of eutectoid (low carbon steels). Consequently, the conclusion with regard to gamma loop limits, or whatever other information the dilatometric curve may present, will not be justifiable unless the experimental procedure was such as to insure at any given instant an approach to equilibrium.

In performing dilatometric studies

upon alloys in which the reaction velocity is low, or in which the amount of the transformed phase is small, it is obligatory to use very low rates of heating and cooling. An alternative may be found in subjecting the alloys to "holding" at any selected temperature at which the phase change may be expected. If the expectation is fulfilled and the reaction does proceed at this particular temperature, plotting the change of length against time will give an *approximate* idea of the rate of reaction.

The alloy of 12.99 per cent chromium, upon holding at 1000 deg. C. for 3 hr. undergoes definite contraction and a formation of gamma phase. Subsequent cooling produces a definite break in the opposite direction which indicates a *slow* transformation of the formed gamma back to alpha. By holding the sample at the temperature corresponding to the beginning of the break as much of the transformation will occur in attaining equilibrium as is allowed by the phase rule. Upon further lowering of the temperature and holding, the transformation will proceed again because an alloy of this composition falls within the field of two phases, the relative amounts of which are governed by the temperature.

The fact that this alloy did not come back to its original length can be explained in part by the previous history of the sample: It was not in true equilibrium when the original heating was begun. Similarly performed experiments on alloys with 15.0 and 17.50 per cent chromium yielded, except for magnitude, identical results. Definite contraction of the alloy with 17.50 per cent chromium occurs on holding either at 1000 deg. C. or 1070 deg. C. Also a different path (with a pronounced break) of the cooling curve and subsequent return of the sample, upon slow cooling, to its original dimensions should be accepted as a well-founded indication of phase change, affecting, in all probability, but a very small portion of the sample.

In the alloy with 18.20 per cent chromium, the magnitude of the transformation at high temperatures was found so small, even after prolonged holding, as to be hardly perceptible.

Without any attempt, at the moment, to explain these experimental results, the conclusions as to laboratory facts are as follows:

(a) At a certain chromium concentration, alloys of fair purity are characterized by rapid modifications in some of their properties. This change is not governed either by carbon percentage or by impurities in the ordinary sense of the word.

(b) Further, these alloys, contrary to orthodox understanding (the Curie or magnetic point is not considered), undergo some transformation which may or may not be a simple phase change (alpha to gamma and reverse).

Disregarding the philosophic difficulties of causes and effects, it is much easier in the course of an investigation to observe certain effects than to uncover underlying causes. However true that may be, it must also be remembered that without causes there would not be any effects.

"Causes," as we understand them at present, imply (1) the appearance of a new phase, (2) possible polymorphic transformation, (3) the separation of even minute amounts of impurities, and, finally, (4) a somewhat broadly used expression "a change in the *nature* of either solvent or solute."

The whole series of alloys, of the compositions listed in Tables I and II were investigated for age hardening. First the alloys were thoroughly homogenized, subsequently reheated to either 788 deg. C., 1065 deg. C., cooled in still air and finally aged at 450 deg. C. and 490 deg. C. for periods up to 425 hr.

Carbonless alloys show a most pronounced and definite tendency to age harden. It will suffice to state that the total increase in hardness for an alloy with 18.20 per cent chromium was, at the end of 425 hours, 19 points on Rockwell "B" scale and the same carbonless alloy with 17.50 per cent chromium showed an increase of 26 points. At the same time, alloys with about 13 and 15 per cent chromium showed much less, in fact, very little tendency to harden.

Similar, almost quantitatively identical, results were obtained on other series of the same alloys, aged under varied conditions. It appears to be quite definitely established that the age hardening property is *directly proportional to chromium concentration*,[2] within the limits studied.

TABLE IV

| Sample | Temp. Deg. C. | Y. P. Lb. per In.² | U. S. Lb. per In.² | Per Cent Elongation in 2 In. | Per Cent Reduction Area | Impact Ft. Lb. |
|---|---|---|---|---|---|---|
| 68 | —70 | 43,300 | 78,700 | 37 | .. | 2.5 |
| 68 | 26 | 34,500 | 66,500 | 35 | 70 | 120.0+ |
| 69 | —70 | 96,500? | 98,700 | 34 | 71 | ... |
| 69 | 26 | 49,400 | 82,500 | 28 | 73 | 98.0 |
| 70 | —70 | 69,000 | 105,200 | 33 | .. | 17.0 |
| 70 | 26 | ..... | 88,000 | 33 | 70 | 85.0 |
| 71 | —70 | 52,700 | 79,800 | 36 | 70 | 2.0 |
| 71 | 26 | 34,500 | 64,700 | 34 | 74 | 65.0 |
| 72 | —70 | 48,000 | 87,400 | 38 | .. | ... |
| 72 | 26 | 39,400 | 73,000 | 32 | 72 | 42.0 |
| 73 | —70 | 56,600 | 93,500 | 32 | 66 | ... |
| 73 | 26 | 47,500 | 81,500 | 29 | 67 | 37.0 |
| 74 | —70 | 63,400 | 95,800 | 34 | .. | 3.0 |
| 74 | 26 | 46,200 | 81,300 | 27 | 67 | 18.0 |
| 75 | —70 | 48,800 | 75,400 | 15* | 13 | 2.0 |
| 75 | 26 | 45,800 | 64,500 | 31 | 69 | 30.0 |
| 76 | —70 | 61,600 | 90,600 | 33 | 63 | ... |
| 76 | 26 | 44,400 | 78,600 | 29 | 66 | 10.0 |
| 77 | —70 | 59,000 | 94,300 | 15* | 13 | ... |
| 77 | 26 | 45,500 | 79,700 | 26 | 68 | 6.0 |
| 77 | 26 | 44,800 | 79,300 | 29 | 68 | . |
| 78 | —70 | 85,100 | 98,800 | 28 | .. | 1.5 |
| 78 | —70 | 68,400 | 101,000 | 29 | 60 | 1.5 |
| 78 | 26 | 49,700 | 83,200 | 28 | 67 | 9.0 |
| 79 | —70 | 67,400 | 83,800 | 23 | .. | 2.0 |
| 79 | 26 | 42,800 | 67,400 | 29 | 68 | 5.0 |
| 80 | —70 | 60,100 | 90,100 | 33 | 63 | .. |
| 80 | 28 | 49,500 | 74,600 | 28 | 70 | 4.0 |

*Broke in threads.

The fact that alloys air-quenched, prior to aging, from 1060 deg. C. show much less susceptibility to age hardening than if quenched from 787 deg. C. becomes quite significant in the light of already discussed dilatometric work. If, as it was suggested, some gamma iron is formed in alloys with 17.50 and 18.20 per cent chromium, upon heating to high temperature, air cooling of the sample will cause some gamma to forego its complete transformation with consequent increase in initial hardness. Aging would tend to decrease the hardness of this gamma, thus diminishing the total effect of the age-hardening process.

Additional data on susceptibility to age hardening with accompanying change in resistance to impact is contained in Table III. The experiment was deliberately confined to the alloys

[2] This *definite* proportionality between the degree of age hardening and chromium content disposes, quite decisively, of the remote, but nevertheless realized, possibility that aging might have been caused by the impurities present in the alloys.

made in the orthodox way. The loss of resistance to impact in the alloys between 16 and 19 per cent chromium with 0.02 per cent carbon is quite astounding.

I admit that it was with deliberation when I spoke just a few minutes ago, of observed effects and the difficulties in uncovering underlying causes. The aging of chromium alloys is an effect. You will probably agree with me that the explanation is neither simple nor obvious. The questions to which I should like to have a definite answer would be (a) what is the actual process of age hardening in iron-chromium alloys and (b) is it a true case of precipitation hardening and if so what is the precipitated constituent?

Assumption of the existence of the compound FeCr within certain limits of concentration suggests an explanation, admittedly speculative, of age hardening. Is it not possible that with much prolonged time of heating (approach to equilibrium) the limits of compound formation may be found to extend far beyond those sketched by previous investigators?

The indisputable proof would have been forthcoming if it could be shown that the samples of 16 to 20 per cent chromium aged for 425 hr. (or approximately 18 days) contained the compound FeCr in equilibrium with iron-chromium solid solution.

By means of X-rays several alloys were investigated. No new lines appeared in the aged samples and their photograms were identical with those for unaged samples. The lines in the aged samples were found to be somewhat more diffuse, but the difference was not sufficient to be considered as significant. The measurements of the lattice parameter before and after aging were found to be unchanged, making allowances for experimental error.

The results of microscopic examination were equally negative. Although the aged samples appeared to be reacting toward etching reagents somewhat differently and, at times an anxious eye believed that it was seeing small agglomerations of precipitate, especially at grain boundaries or slip planes, the hoped for and conclusive evidence was not found. Of course, it is not altogether surprising. In the first place, the aging phenomenon is not necessarily caused or accompanied by precipitation in the ordinary sense—a well known example being duralumin. Dr. Merica has cautioned that "age hardening may also occur in consequence of some structural alteration other than that of the precipitation of excess solute."

But even if we *assume*, at present we would not be justified to use any other word, that age hardening of chromium-iron alloys is caused by *actual precipitation* of a constituent —the amount and the degree of agglomeration must be considerable before it would be detected either by microscope or by X-rays.

TABLE V

| Alloy No. | Composition Cr Per Cent | Composition C Per Cent | Impact Resistance in Foot Pounds: Broken at 30 Deg. C. | Heated to 92 Deg. C., Broken at 92 Deg. C. | Heated to 92 Deg. C., Held 3 Hr., Cooled Broken at 30 Deg. C. | Refrigerated to —78 Deg. C. and Broken | Refrigerated to —78 Deg. C. Broken at 30 Deg. C. |
|---|---|---|---|---|---|---|---|
| F12 | 11.82 | 0.010 | 120.0 | .... | ... | 2.5 | 182.0 |
| W14 | 12.96 | 0.008 | 130.0 | .... | ... | 3.0 | 132.0 |
| W16 | 14.95 | 0.008 | 88.0 | .... | ... | 5.0 | 74.0 |
| F18 | 17.50 | 0.010 | 8.5 | 234.0 | 12.0 | .. | .... |
| F20 | 18.20 | 0.012 | 8.0 | 135.0 | 7.0 | .. | .... |

## Impact at Low Temperature Studied

The impact brittleness of some metals at sub-zero temperatures, definitely known to be independent of any phase change, is well known. The analogy between this phenomenon and the behavior of iron-chromium alloys appeared to be rather striking. Additional experimental work was thought to be justifiable and to it we will now turn our attention. It was merely hoped to collect further data pertaining to the system under discussion, and, thus, further point out the complexity of the subject and the necessity for additional work in this field.

In executing this part of the investigation, alloys as listed in Tables I and II were tested for impact at *several* temperatures between 76 deg. C. and 90 deg. C., while tensile properties were ascertained only at two temperatures, namely 76 deg. C. and 30 deg. C. (room). All the tests were made *at temperature*. The results are summarized in Table IV.

The ductility *in tension is not* adversely affected by refrigeration to —76 deg. C. In fact, in the majority of cases it is slightly improved, in spite of noticeably increased tensile strength (the latter observation is general for all alloys). But the ductility as measured by *impact* varies within unexpectedly wide limits, regardless, it seems, of carbon content and of previous heat treatment.

More specifically, the following observations concerning impact properties are justified by the evidence: At —76 deg. C. *all of the alloys* are exceedingly brittle. At room temperature (30 deg. C.) sharp demarcation between ductility and brittleness occurs somewhere between 16.75 and 18 per cent chromium. At 50 deg. C. carbonless alloys remain practically unchanged, but those containing carbon and with 33 per cent chromium is hopelessly brittle. In other words, the higher is the chromium content the higher is the temperature at which ductility is regained.

These observations, it will be agreed, parallel those of iron, providing that it is ascertained that no change of physico-chemical nature (polymorphic modification, appearance of a new phase) has taken place at low temperatures: Accordingly, alloys were immersed in a liquid at —78 deg. C., held for ½ hr. (time sufficient to produce brittleness if tested at this temperature), removed, and broken next day at room (30 deg. C.) temperature. The results are shown in Table V.

The reversibility of impact "brittleness" and impact "toughness" (ductility) with the temperature of test obviously excludes the possibility of a permanent change in the alloy at least within the periods used for either refrigeration or treatment in boiling water. It would be exceedingly interesting to ascertain the influence of much longer holding at subzero or slightly elevated temperatures on the properties of alloys.[a] But this would constitute another problem.

Wherein, then lies the explanation for the observed intricate behavior of chromium-iron alloys? Any metal or alloy yields to stresses through cleavage, slip, and twinning. It should therefore be suggested that the resistance of any metal or alloy to rupture is determined by its characteristic cohesive strength (ideal resistance to cleavage) and its resistance to slip (shear). The relative efficiency of these resistances determines the alloy's properties, that is either toughness or brittleness. With the *changing* temperature of test, the relative values for the two mentioned resistances do not remain the same. This is, of course an explanation well known to those who have studied this particular subject. Extending this reasoning to the properties of iron-chromium alloys at room temperature

[a] Will the temperature of boiling water induce precipitation hardening?

TABLE VI

| Alloy Composition Cr Per Cent | $N_2$ Per Cent | C Per Cent | Treatment | Modified Charpy, Ft.-Lb. |
|---|---|---|---|---|
| 17.84 | 0.207 | 0.01 | Normalized from 1650 deg. F. | 3–4 |
| | | | Annealed at 1400 deg. F., air-cooled | 15.0 |
| | | | Very carefully annealed, slowly cooled | 72.0 |
| 18.26 | 0.145 | 0.006 | Normalized from 1650 deg. F | 120.0 |
| | | | Quencher in oil and drawn at 1400 deg. F. | 113.0 |
| | | | Annealed at 1400 deg. F., and air-cooled | 83.0 |

it may perhaps be suggested that changing chemical composition in the series of binary alloys produces the same effect as the described influence of the temperature of test. An interesting observation pertinent to the discussion is found in examining break structures. The structure at the break of alloy W-16 (chromium 14.95 per cent, carbon 0.008 per cent) shows wavy appearance of the strain lines. The same alloy broken at −78 deg. C. (5 ft. lb. impact resistance) shows no distortion (slip) at all, even at the very edge of the broken part. Quite similarly, alloys which show either ductility or brittleness at room temperature (depending, as was described, upon their composition) exhibit the same structural characteristics. Would it be far too speculative to suggest—as a possible explanation—the dependence of cleavage and slip resistance at room temperature upon the distortion of the parent lattice through introduction of foreign atoms? What would be the effect of the manner of distribution of participating atoms within metallic bodies? All these possibilities should affect the manner of "binding" or "bonding" between atoms — the circumstance previously termed as "the change in the nature of solid solution." But all of them constitute at present terra incognita.

## Gaseous Impurities Examined

Among the impurities in metals and alloys should be listed such gaseous elements as oxygen, and nitrogen. Alloys of iron and chromium, prepared with such infinite pains on the part of my collaborator in experimental work, Mr. Rush Lincoln, contained very small amounts of the above mentioned elements: That they could have an influence upon the phenomena described should be adjudged most unlikely. Thus, instead of attempting to reduce further the impurities—confining this expression to oxygen, hydrogen, and nitrogen, it was decided to study the influence of their increasing amounts. Of these three, nitrogen has recently received some prominence and its study in relation to ferrous alloys was undertaken first. The information revealed by a few preliminary experiments justified continuation of the work. And so, the discussion of impurities is reduced to the discussion of nitrogen in iron-chromium alloys, leaving the question of other gases for some future communication.

While the general subject of gases in iron-carbon steels and non-ferrous metals and alloys has been extensively studied, the interaction between special alloys (including alloy steels) and gases received only scant attention.

It is not unreasonable to anticipate that the tendency of a certain alloy to absorb a gaseous element or to combine with it will be determined to a large extent by the same tendency on the part of the metals making up an alloy. Iron has a notoriously low capacity for absorbing nitrogen: Even at high temperatures and pressures the maximum nitrogen found in iron is from 0.005 to 0.04 per cent (by weight, the latter figure at the melting point.) The figures for hydrogen, according to Sieverts and Martin are also very low, even lower than for nitrogen. Among other metallic elements molybdenum will take up very little hydrogen and virtually no nitrogen, which is also true of cobalt and tungsten. Much difference of opinion exists regarding silicon and the influence of increasing amounts of silicon in iron on its absorbing, or as Martin calls it "occluding," capacity for both nitrogen and hydrogen. The behavior of manganese is also debatable, but this much can be said: It was observed in our laboratories that during the attempt to remelt previously distilled manganese under an atmosphere of non-purified argon, the manganese picked up some nitrogen which was present in small amounts in the argon. The element chromium, however, has an astounding affinity for nitrogen, with the strong probability that a nitride is formed.

Realizing this unusual affinity of iron-chromium alloys for nitrogen, it appeared indeed desirable and important to ascertain the influence of nitrogen on the constitution and properties of the chromium alloys.

Dilatometric observations immediately disclosed a very pronounced influence of nitrogen on the phase relationship in nitrogen-bearing alloys. It will be remembered that alloys of 18 per cent chromium are characterized by continuous, smooth "length-temperature" curves on which the existence of gamma to alpha transformation will be manifested only under special procedure for observations. The typical curve for the similar alloy but with nitrogen proves the existence of a definite, sharply defined transformation, both on heating and cooling.

With smaller percentages of nitrogen the magnitude of the transformation diminishes, but the temperature range remains, apparently, unaffected. In other words, addition of nitrogen results in the formation, under equilibrium conditions, of increased amounts of the gamma phase, very much like carbon. In fact, nitrogen appears to be a more powerful factor than carbon: The volume change noted in nitrogen bearing alloy is definitely greater than in the alloy with carbon in similar amount. This conclusion was fully substantiated later by microscopic observations. Similarly with carbon alloys, the transformation in nitrogen containing alloys can be made to occur at any temperature between 200 deg. and 800 deg. C., depending on the rate of cooling. And, as should be expected, the common mechanical properties of the alloys undergo radical changes when such alloys are subjected to the proper heat treatment.

The limited amount of material on hand precluded an exhaustive study of mechanical properties, although it was possible to determine impact toughness in two important alloys. By controlling the nitrogen content and with proper heat treatment, impact characteristics, far above those obtainable in alloys without nitrogen, can be easily secured. An illustrative summary will be found in Table VI.

## A Failure of Stainless Steel

STAINLESS steels do not always meet the expectations of some applications rather hastily installed without very careful investigation. According to reliable reports, piping of stainless steel has been used in some large vessels for pump lines which handle sea water. These pipes have proved a failure, not so much from the corrosion standpoint as from the fact that they filled up with marine growths.

The pipe is being displaced with a material containing copper, such as copper steel, monel metal and so on. The advantages of this material consist in the fact that enough copper is soluble in the sea water so that the marine growth is poisoned and does not deposit itself on inside of pipes. Thus a clean interior is assured.

# Steels for Die-

By SAM TOUR, Vice-president,

HEAT checks in steel are the source of trouble in many industries besides that of die casting. Every shop where metals are subjected to hot working is searching for improvement and hoping for a cure. The development of a material of sufficient strength to be used as a die and yet devoid of the property of heat checking would be a godsend to many shops and many industries.

The need for thorough study and research on the subject is evidenced by the wide variety of hot-working die steels on the market. It is peculiar, but true, that in practically every case the maker of the steel can give concrete evidence to prove his contention that his type of hot-working die steel is as good as or better than any other. A number of steel companies have several hot-working die steels from which choice can be made to fit a particular set of requirements.

Possibly to expect one material to be universally the best hot-working die steel is unreasonable. In some hot-working operations, as in drop forging, the die must have great toughness to withstand the stresses developed; in other operations, as in hot piercing or punching, resistance to erosion at high temperatures, possibly defined as strength and hardness at elevated temperatures, is required. In still others, as in die casting, only sufficient hardness to resist scoring between moving surfaces is required, whereas the resistance to sudden changes in temperature must be at a maximum.

### Formation of Heat Checks

Heat checks, in the writer's opinion, are due to strains set up by repeated changes in temperature, and these strains, at some time or other, set up stresses that exceed the elastic limit or fatigue limit of the material in question. The amount of strain is a function of the difference in temperatures between two adjacent parts of the same block of steel; in other words, the temperature gradient. Assuming that the modulus of elasticity of steel is approximately independent of composition, the following properties should be sought for in the effort to obtain a steel with maximum resistance to heat checking: (1) minimum coefficient of expansion; (2) maximum thermal conductivity; (3) maximum elastic limit; (4) maximum endurance limit.

If we consider that the stresses are developed rapidly by sudden heating, we must also bear in mind that the application of stress has somewhat the nature of an impact and we must, therefore, add a high impact value to the list of the desirable qualities of a die steel. In most cases the die, during operation, becomes hot. We must, therefore, consider all of these properties from the standpoint of this temperature. In other words, the desired high elastic limit and the desired high impact strength, etc., should be at the elevated temperatures.

Daeves found that a steel containing 13 per cent Cr, 0.5 per cent Ni, 0.7 to 1.00 per cent C has a coefficient of expansion less than that of ordinary alloy steels such as studied by Mathews, but Daeves also found this steel to have a lower heat conductivity than carbon steels.

Mathews found that for the ordinary types of alloy steels in the heat-treated condition and in the ranges as shown there was very little variation in this property.

Langenberg found that heat-treated chromium-vanadium steel has maximum notch-bar impact strengths at temperatures between 200 and 500 deg. F. At 1000 deg. F., the highest temperature he investigated, the chromium-vanadium steel was considerably weaker than between 200 and 500 deg. F. He found nickel-chromium steel to have maximum impact strength between 200 and 750 deg. F., its strength apparently holding over a greater range. Of all the steels that he tested the nickel-chromium steel of composition as follows seemed to be the best in this respect: C, 0.39 per cent; Mn, 0.46; P, 0.03; S, 0.025; Si, 0.22; Ni, 3.44; Cr, 1.58.

Moore, Komers and Jasper in their studies of the fatigue of metals, arrive at the conclusion that for ferrous metals at least the endurance limit furnishes the best criterion of resistance to repeated stress with the ultimate tensile strength or the Brinell hardness (which seems to be related to ultimate strength) as a somewhat less reliable index. These investigators call attention to the need of an investigation of the strength of steel under repeated stress and at elevated temperatures.

Work at the General Electric Co. has indicated clearly that there is a relation between the results of notched-bar impact tests and those of notched-bar fatigue tests. Two pieces of steel apparently identical as rated by tensile strength, hardness, elongation, reduction of area and unnotched impact strength may have widely different notched-bar fatigue resistances, and when they do they also have widely different notched-bar impact strengths. The General Electric work shows this on both Izod and Charpy types of impact tests.

### Practical Requirements of a Steel for Die-Casting Dies

From the practical standpoint of the user—the die-casting company—the requirements for a steel for dies for casting aluminum, for example, can be listed as follows:

1. Machinability.
2. Stability in heat treatment.
3. Resistance to heat checking.
4. Resistance to deformation, battering, etc.; i.e., hardness.
5. Resistance to cleavage cracking on sudden heating or cooling; i.e., toughness.
6. Resistance to erosive and solvent action of molten aluminum.
7. Cleanliness and uniformity.
8. Cost—producibility, forgeability, etc.
9. Properties at elevated temperatures.

THE name Sam Tour for more than a decade has been virtually a synonym for die castings. Some years ago, one of the Tour contributions on the subject was a discussion of heat checks or thermal cracks in die-casting dies. In New York, Oct. 3, at a meeting

# Casting Dies

Lucius Pitkin, Inc., New York

held by the American Institute of Mining and Metallurgical Engineers, the same author presented additional observations on the subject and offered suggestions as to methods for further attack of the problem. This latest paper is here reviewed at length.

*Machinability.*—From the standpoint of machinability chrome-vanadium steel seems to be quite satisfactory. Hot-working tungsten steels are much more difficult to machine than the chrome-vanadium steels and are considered just barely passable in the die-casting industry today. Austenitic steels, in general, are out of the question. Possibly the austenitic steels could be made more machinable by the addition of zirconium sulfide, or something of that nature, but it is doubtful whether even if this could be done the steels would be suitable for die-casting dies.

*Stability in Heat Treatment.*—The standard chrome-vanadium steel used for many years for dies is not satisfactory because of its tendency to warp, grow, shrink and crack during the heat-treating process. The tungsten-chromium type of air-hardening die steels are all quite satisfactory from the standpoint of stability in heat treatment. The tungsten-chromium type of oil-hardening die steels are somewhat dangerous, inasmuch as it is common practice in the manufacturing of die-casting dies to have blocks cut up with very heavy sections next to very thin sections, and with sharp corners between the two, and a steel that requires oil quenching is liable to crack at these weak points. In general, it seems as though the air-hardening type of steel, whether it contains tungsten or not, is preferable for general purposes.

*Resistance to Heat Checking.*—The failure by heat checking of die blocks of any one steel seems, to some extent, to be a function of the hardness. In practically all steels tested or used, die life seems to be determined, so far as heat checking is concerned, by the initial hardness. Up to the point where insufficient toughness remains in the steel it seems to be true that the harder the block the longer it will stand up. As the hardness increases there is a gradual and characteristic change in the type or configuration of the heat checks. Hardness, however, is not alone the entire answer, as is indicated by the fact that plain carbon steels of 400 Brinell are inferior to chrome-vanadium steel of the same Brinell hardness. Also, chrome-vanadium steel of 430 Brinell is inferior to chrome-tungsten steel of the same Brinell hardness.

*Hardness.*—Apart from the relation of hardness to resistance to heat checking, there is required a certain amount of hardness in any block, for service reasons. Dies are made up of moving parts, slides, cores, pins, etc., and usually are hot when in operation. All die parts must be hard enough so that excessive rubbing and scoring and eventual seizing of the parts does not occur. It is possible to have soft main or stationary blocks in a die and hardened moving pieces, but it is preferable to have all the main parts of the die made of the same steel and hardened. Moving parts can be left a bit harder than the stationary parts. All blocks should be hard enough to resist defacement or deformation due to the powerful closing action of the machines when stray pieces of metal are accidentally caught somewhere on the parting faces of the die. About 325 Brinell hardness is as low as is permissible for main blocks in this connection. From the standpoint of resistance to heat checking, the minimum hardness is considerably above 325. For example, it has been found that the hot-working die steels of the chrome-tungsten type develop heat checking rapidly at Brinell hardnesses around 325 and at such hardnesses are apparently inferior to chrome-vanadium steel, whereas if the two steels are compared at Brinell hardnesses at 430 the chrome-tungsten steels are superior to chrome-vanadium steels.

*Cleavage Cracking.*—This is a difficulty that is not at all serious in the chrome-vanadium steels except when they are left at a Brinell hardness of above 477. In the chrome-tungsten steels cleavage cracking is a serious problem and does not seem to have much relation to the Brinell hardness of the block of steel, but seems to be more closely associated with its macrostructure. Some chrome-tungsten blocks develop serious cleavage cracks at hardnesses as low at 340 Brinell, whereas others of the same analysis do not develop such cracks even at hardness as high as 477. In most cases where serious cleavages occur in chrome-tungsten steel the fracture shows evidence of a fish-scale or a marble structure. As this structure is usually associated with brittleness, it would seem that cleavage cracking is a function of brittleness. The most promising test for this is the notched-bar impact test, and it seems that a steel of a high impact strength at the hardness at which it is to be used is least subject to cleavage cracking.

*Erosive and Solvent Action of Molten Aluminum.*—Erosion and solvent or soldering action of molten aluminum and its alloys on the die steels is likely to occur at the gates, where the aluminum is at maximum temperature and is made to travel at high velocities across the steel, thus eroding and attacking the steel. A thin oxide layer or an applied layer of graphite prevents this solution attack if the layer can be kept in place and withstand the erosive action of the stream of metal. This erosive action sometimes becomes severe where the molten metal impinges directly upon a steel surface. Resistance of the steel to solvent action is therefore to be preferred although this matter should not be considered of major importance. For years statements have been made that nickel steels are not suitable for dies for aluminum die casting, because of this solvent action. That this is not true is indicated by the promising results obtained by the

writer some years ago on several steels containing up to 5 per cent of nickel. The nature of the surface seems to be more important than the composition of the base.

*Cleanliness and Uniformity.*—Cleanliness and uniformity of a die steel are essential. Segregations and nonmetallic inclusions are starting points for thermal fatigue failures and cleavage cracking. Segregations appearing as hard spots cause great difficulties in die sinking. Internal seams, slits, cracks and other defects must not be encountered at or near the base of a die impression after the greater part of the die sinking has been done. Ample top and bottom discards must be taken from the ingot. Ingots and ingot molds and teeming practice must be regulated to avoid secondary piping, slag inclusions, oxide inclusions, etc. Heating, forging and annealing must eliminate all ingotism and develop uniform structure throughout the section of the finished piece, and must not develop seams, cracks, hammer bursts or other defects.

*Cost.*—The finished steel for dies for aluminum die casting must be producible at a reasonable price not only from the standpoint of cost of ingredients but also from the standpoint of manufacturing costs in connection with melting, pouring, cogging, discards, chipping, annealing, forging, etc. It seems as though the die-casting trade will stand prices up to 40c per pound but not much above that figure, and desires prices considerably below that.

*Properties at Elevated Temperatures.*—In service, dies for casting aluminum are subjected to temperatures from room temperature or lower (cooling-water temperatures) up to 800 or 900 deg. F., or possibly higher. Small uncooled parts, for example, near the gate and almost completely surrounded by the aluminum casting, may conceivably become heated almost to the temperature of the incoming metal. Casting temperatures in die casting of aluminum range from 1125 to 1400 deg. F., with the average temperature possibly in the range from 1200 to 1250 deg. F. It is, of course, conceivable that in many cases the surface layers of the die steel, before the body of the blocks of steel can conduct the heat away, become heated to a red heat. For this reason, therefore, red hardness seems to be a desirable property for a die-casting die steel. It is also important that the steel maintain a relatively high elastic limit and impact strength at these elevated temperatures. In other words, the elastic limit and impact-strength curves should preferably have no low areas or inverse deflections from room temperature up to say, 1000 deg. F.

TABLE 1.—RESULTS OF TENSILE TESTS

| Steel | Original Area, Sq. In. | Yield Point, Lb. | Maximum Load, Lb. | Yield Point, Lb. per Sq. In. | Tensile Strength, Lb. per Sq. In. | Elongation In. | Elongation Per Cent | Reduction of Area, Per Cent | Brinell Hardness | Fracture |
|---|---|---|---|---|---|---|---|---|---|---|
| 527 | 0.2003 | 52,700 | 55,720 | 263,100 | 278,200 | 0.16 | 8.0 | 19.2 | 512 | Fine granular with silky lip. |
| 528 | 0.2003 | 51,800 | 55,280 | 258,600 | 276,000 | 0.24 | 12.0 | 41.9 | 532 | Silky ½ cup. |
| 531 | 0.2003 | 47,860 | 49,480 | 238,930 | 247,000 | 0.28 | 14.0 | 44.9 | 477 | Silky ½ cup. |
| 532 | 0.2003 | 52,500 | 56,030 | 262,100 | 279,700 | 0.07 | 3.5 | 5.1 | 532 | Fine granular with silky lip. |
| 533 | 0.2003 | 49,100 | 51,640 | 245,100 | 257,800 | 0.20 | 10.0 | 30.9 | 512 | Fine granular with silky lip. |

## Testing Die Steels in Die-Casting Plants

In plants where the center-gate die-casting machine is used there is a standard part known as the gate former or gate bushing. In these plants often new die steels are tested by making up a few gate formers. The writer has tried out many different kinds of proposed die steel in this way.

Another method of testing a proposed new steel is to insert a block of it in a die. This is common practice in plants that use the split-gate type of machine, which has no gate former. The difficulty in this type of testing is that when a special block is inserted in a given die it is necessary to wait until the die-casting company's customer who owns the die orders a sufficient number of castings to show the actual service the steel will render. This often takes years, and sometimes can never be accomplished because the customer changes his design or his source of supply or discontinues the part.

Another common practice is to use the new steel in the form of a sprue cutter or splitter pin. This is the gate post in many dies on the center-gate machine, and takes the full force of the incoming metal. In most cases, these splitter pins are not very carefully machined, are not held to close dimensions because they do not form a part of the finished casting, are not water-cooled, and are not given close attention. In general, it is difficult to obtain any important information in tests of sprue cutters, except from the standpoint of the soldering action of the aluminum on the proposed die steel. Even this is sometimes at fault because often it is desirable to have the metal stick to the sprue cutters to some extent, and no effort is made to keep the sprue cutter coated with graphite and oil to prevent the solvent action. If the sprue cutter were a part of the die, the attention given it would be entirely different, and possibly the net result on the steel would differ considerably.

A method of testing sometimes used is known as "total immersion." A block, for instance a 2-in. cube, of the proposed die steel is dropped into a molten bath of aluminum together with a similar block of a known steel and allowed to remain in the molten aluminum for a number of days. When it is taken out the aluminum is cleaned off as well as possible and the weight losses are determined. This is truly a solvent action test and therefore is not indicative of what the steel might do in resisting heat checking. It is well known that cast iron is much less soluble than steel in molten aluminum; therefore, although cast iron is not a suitable material for die-casting dies for aluminum, it stands up much better than any of the standard die steels in this total immersion test. It is interesting to note, however, that one or two special steels have seemed to stand up better in aluminum dies than chrome-vanadium, and also to have less tendency to go into solution in molten aluminum in this total immersion test than chrome-vanadium steel. It is the writer's belief, however, that these results are not important and that normally the total immersion test is not of much value in evaluating different proposed die steels.

A proposed method for testing new die steels might be termed the "alternate immersion method" with water cooling. In this test the samples of die steel are mounted on a crank arm so as to be alternately dipped into and taken out of a bath of molten alumi-

num eight or ten times per minute. The specimens are drilled so that water may be circulated through them to maintain them at a fairly low temperature. A counter on the crank arm makes it possible to determine the total number of cycles gone through until the time that heat checking begins to appear. Ten or twelve different steels can be tested at once in this manner. The test is not a duplication of the conditions in a die-casting die, because the molten metal does not strike the specimens as suddenly and the contact between the molten metal and the steel is not as intimate as when the molten metal is forced against the steel under considerable pressure and with considerable velocity.

## Laboratory Testing

A die-casting company wants to know a number of things about a new steel before putting it to a test in service. This information should be supplied by the mill proposing the steel, and can be determined by laboratory methods of testing somewhat as follows:

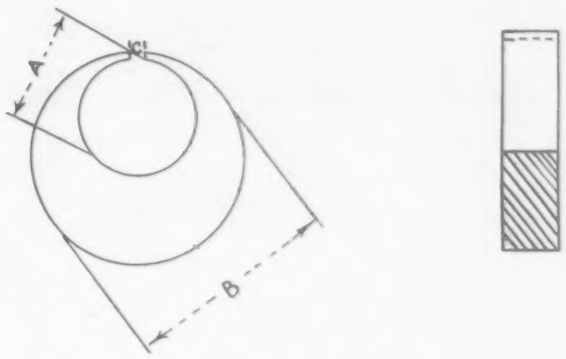
The various transformations occurring in the steel upon heating and cooling are first to be determined, which can be done easily by the use of a Rockwell dilatometer furnace. From the transformations on heating and cooling as shown by the dilatometer curves the proper heat-treatment temperatures for the proposed steel can be selected. From a heat-treating standpoint, it is desirable next to know whether or not small and large pieces of the steel will heat-treat at the same temperature or whether higher temperatures will be required for the large pieces. In other words, the depth of hardening of the steel is to be determined, and this usually is done by the heat treatment of a small piece and a large piece simultaneously and checking up the finished hardness of the pieces. In this, of course, it is to be remembered that small pieces do not have to be soaked at temperature as long as the large pieces, but the actual temperature should be the same irrespective of the size of the piece.

The next thing to determine is the amount of dimensional change occurring in the steel as a result of various heat treatments. This can be carried out by the actual heat-treating of U-shaped blocks of steel. Such blocks of steel as machined up are carefully measured, then given the quenching treatment as determined by the previous test; again carefully measured, then drawn and again measured; completely annealed and again measured, then rehardened and again measured, and, finally, drawn again and measured.

Other laboratory tests to be carried out are Brinell hardness, tensile strength and elastic limit, and notched-bar impact tests at room temperature and at 200, 350, 500, 650 and 800 deg. F.

Finally the proposed steel should be examined metallographically to see that it is clean, free from non-metallic inclusion and uniformly free from serious segregation; also, to see that it has a uniform grain structure, free from abnormally large grains, outstanding grain boundaries, and so forth.

**Table 2—Results of Movement Tests**




| Heat-Treated Condition | | Normalized | Hardened | Drawn | Variation |
|---|---|---|---|---|---|
| No. 527 | A | 2.8992 | 2.9000+ | 2.9030+ | +0.0038 |
| | B | 4.9957 | 4.9975+ | 4.9995+ | +0.0038 |
| | C | 0.5020 | 0.5195+ | 0.5200+ | +0.0180 |
| No. 528 | A | 2.9031 | 2.9022— | 2.9042+ | +0.0011 |
| | B | 4.9930 | 4.9905— | 4.9933+ | +0.0003 |
| | C | 0.5018 | 0.5070+ | 0.5085+ | +0.0067 |
| No. 531 | A | 2.9114 | 2.9032— | 2.9044+ | —0.0070 |
| | B | 5.0082 | 5.0023— | 5.0032+ | —0.0050 |
| | C | 0.5180 | 0.5115— | 0.5120+ | —0.0060 |
| No. 532 | A | 2.8995 | 2.8975— | 2.8980+ | —0.0015 |
| | B | 4.9971 | 4.9981+ | 4.9997+ | +0.0026 |
| | C | 0.5021 | 0.5014— | 0.5012— | —0.0009 |
| No. 533 | A | 2.9003 | 2.8984— | 2.8980+ | —0.0023 |
| | B | 5.0025 | 5.0037+ | 5.0027— | +0.0002 |
| | C | 0.5022 | 0.5000— | 0.5005+ | —0.0017 |

## Tests of New Compositions

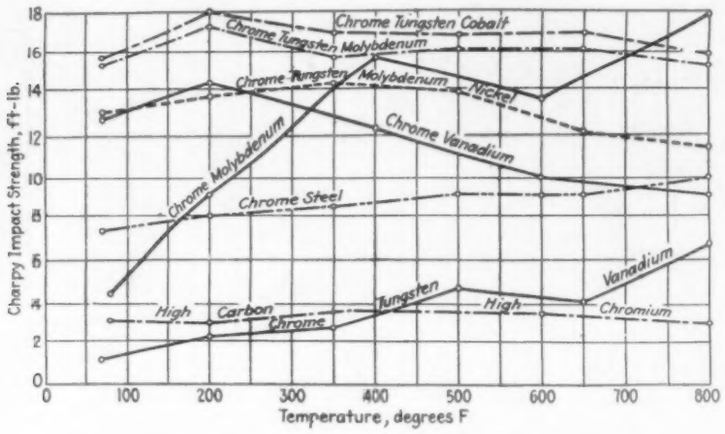
In cooperation with the Vanadium Alloy Steel Co. a number of proposed compositions were studied. Steels of five different analyses were melted and forged into 4-in. cubes. All steels after forging were annealed by sealing in a tube and cooling slowly from 1575 deg. F. Decarburized surfaces were then removed by machining and the blocks heat-treated by cooling in still air from 1900 deg. F. The blocks were then compared for the degree of scale present.

The No. 527 steel was found to possess a thin scale, which was very adherent and difficult to remove. Steel No. 528 had a heavy, adherent scale, which also was hard to remove. No. 531 had a thin adherent scale less in amount than that observed on the No. 527 steel and easier to remove. Steel 532 possessed a heavy adherent scale difficult to remove, while steel 533 had a heavy scale, which was loosely adherent and easy to remove. It was apparent that steel 531 possessed the best properties in this regard.

Brinell tests were taken to observe the hardening properties of the various steels, and these results, together with the compositions of the metals, are here tabulated. Hardness tests after drawing to 1075 deg. F. are also indicated.

Forgings for movement and tensile tests were made from the five blocks used for hardness tests, the forgings for movement tests being finished to 5⅛ in. round by 1⅛ in. thick and forgings for tensile test specimens to ⅞ in. square by 14 in. long. All forgings were then annealed at 1575 deg. F.

The tensile test specimens were matched to 0.512 in. in order to allow for movement and removal of surface after heat treatment. They were then heated to 1900 deg. F., air-cooled and drawn for 1 hr. at 1075 deg. F. After this treatment they were cleaned up and finished to 0.505 in.




Impact tests of steels for die-casting dies at elevated temperatures.

The results of the tensile tests are shown in Table 1.

The movement test specimens were normalized in pitch coke at 1250 deg. F. before any measurements were taken. They were then measured; hardened by packing in pitch coke and heating to 1900 deg. F., then cooled in still air. After remeasuring they were drawn at 1075 deg. F. and again measured. The results of these tests are given in Table 2.

## Impact Strengths at Elevated Temperatures

As already mentioned, die-casting dies are subjected to sudden stresses due to local and sudden heating. In service, die-casting dies for aluminum operate at temperatures varying from cold up to as high as 800 deg. or 900 deg. F., or possibly higher. Die steels fail by developing large cracks or fine heat checks. Failures are accentuated by the presence of surface imperfections, such as scratches, indicating that the notch effect must be taken into consideration. It would appear, therefore, that a good steel for dies for casting aluminum should have a relatively high impact strength at elevated temperatures, and that there should be no low areas in the impact-strength temperature curve for the range from room temperature up to 800 deg. or 1000 deg. F.

Of the number of different steels made up experimentally by the Vanadium-Alloys Steel Co., two steels, Nos. 528 and 531, seemed most promising from the results of the heat-treating, scaling and dimensional change tests. Therefore Charpy impact - strength temperature curves were plotted for these two steels.

Fifteen to 18 Charpy impact-test specimens in the machined and heat-treated condition were supplied by the Vanadium-Alloys Steel Co. for each of the steels 528 and 531, for a chrome-vanadium steel and for No. 527 steel. Additional sets of Charpy impact-test specimens in the machined and heat-treated condition were supplied by the Hoover Co. for each of two additional steels.

Testing was carried out on an Amsler impact-testing machine of the Charpy type with a pendulum with a delivering capacity of approximately 120 ft.-lb. of energy. One-half of each of the broken specimens was carefully tested for Rockwell hardness. Tests were made by the Hoover Co. on two more steels and their results are included in this paper. All results and analyses are here shown.

The average Rockwell hardness of the No. 527 specimens was slightly lower than that of the No. 528 and No. 531 specimens. Also, the 531 specimens were slightly harder than the 528 specimens. It is significant that the impact strengths are lower for the material having higher Rockwell hardness. The considerably lower impact strength, however, for steel No. 531 as compared to No. 528 seems to be more than could be accounted for by the slight variation in Rockwell hardness. The fact that the impact - strength decreases continuously from a temperature of 350 deg. in steel No. 531 seems to be significant also as compared to steel No. 528. In general, it might be concluded that so far as impact strength temperature is concerned steel 528 is the equal of steel 527.

The chrome-molybdenum and the chrome-vanadium alloy steels have the greatest variation in impact strengths, the latter having its maximum strength of 14.33 ft.-lb. at 200 deg. F. and falling off consistently to its minimum of 9.17 ft.-lb. at 800 deg. F. The chrome-molybdenum shows a decided increase in impact-strength from room temperature to 400 deg. F., but at 600 deg. F. the impact-strength has fallen off appreciably.

The chrome - tungsten - vanadium steel showed abnormally low impact-strengths throughout, which may be attributed to some treatments of the steel prior to the making of the impact-test bars in which some fish-scale or marble structure had developed. This type of steel oil-quenched, not air-hardened, from 2100 deg. F. and drawn is often used rather successfully for a hot-working die steel.

The high-carbon, high-chrome steel also showed abnormally low impact-strengths throughout. This steel oil-quenched from a lower temperature would probably have yielded higher-impact strengths.

TABLE 3—COMPOSITION OF VARIOUS DIE STEELS

| | Chrome-Vanadium | Chrome-Tungsten-Molybdenum (528) | Chrome-Tungsten-Molybdenum-Nickel (531) | Chrome-Tungsten-Cobalt (527) | Chrome-Tungsten-Vanadium | Chrome | Chrome-Molybdenum | High-Carbon, High-Chrome |
|---|---|---|---|---|---|---|---|---|
| Hardness, Rockwell C.. | 48.0 | 46.5 | 47.4 | 45.7 | 47.0 | 46.5 | 45–47 | 46.0 |
| Composition: | | | | | | | | |
| Carbon ..... | 0.46 | 0.28 | 0.33 | 0.34 | 0.32 | 0.90 | 0.50 | 1.50 |
| Manganese ... | 0.65 | ... | ... | 0.33 | 0.28 | 0.34 | 0.65 | 0.29 |
| Phosphorus .. | 0.013 | ... | ... | 0.018 | 0.019 | 0.011 | ... | ... |
| Sulfur ..... | 0.022 | ... | 0.049 | 0.026 | 0.023 | 0.014 | ... | ... |
| Silicon ..... | 0.34 | 1.27 | ... | 0.96 | 0.51 | 0.22 | ... | 0.34 |
| Nickel ..... | ... | ... | 1.45 | ... | ... | ... | ... | ... |
| Chromium ... | 2.65 | 4.77 | 4.53 | 5.11 | 3.23 | 3.45 | 0.70 | 12.00 |
| Tungsten .... | ... | 1.01 | 1.15 | 5.36 | 9.24 | ... | ... | ... |
| Molybdenum .. | ... | 1.50 | 1.06 | ... | ... | ... | 0.35 | 1.00 |
| Vanadium .... | 0.20 | ... | ... | ... | 0.47 | ... | ... | 0.75 |
| Cobalt ..... | ... | ... | ... | 0.50 | ... | ... | ... | ... |

# American Industries Display Their Wares at National Metal Exposition

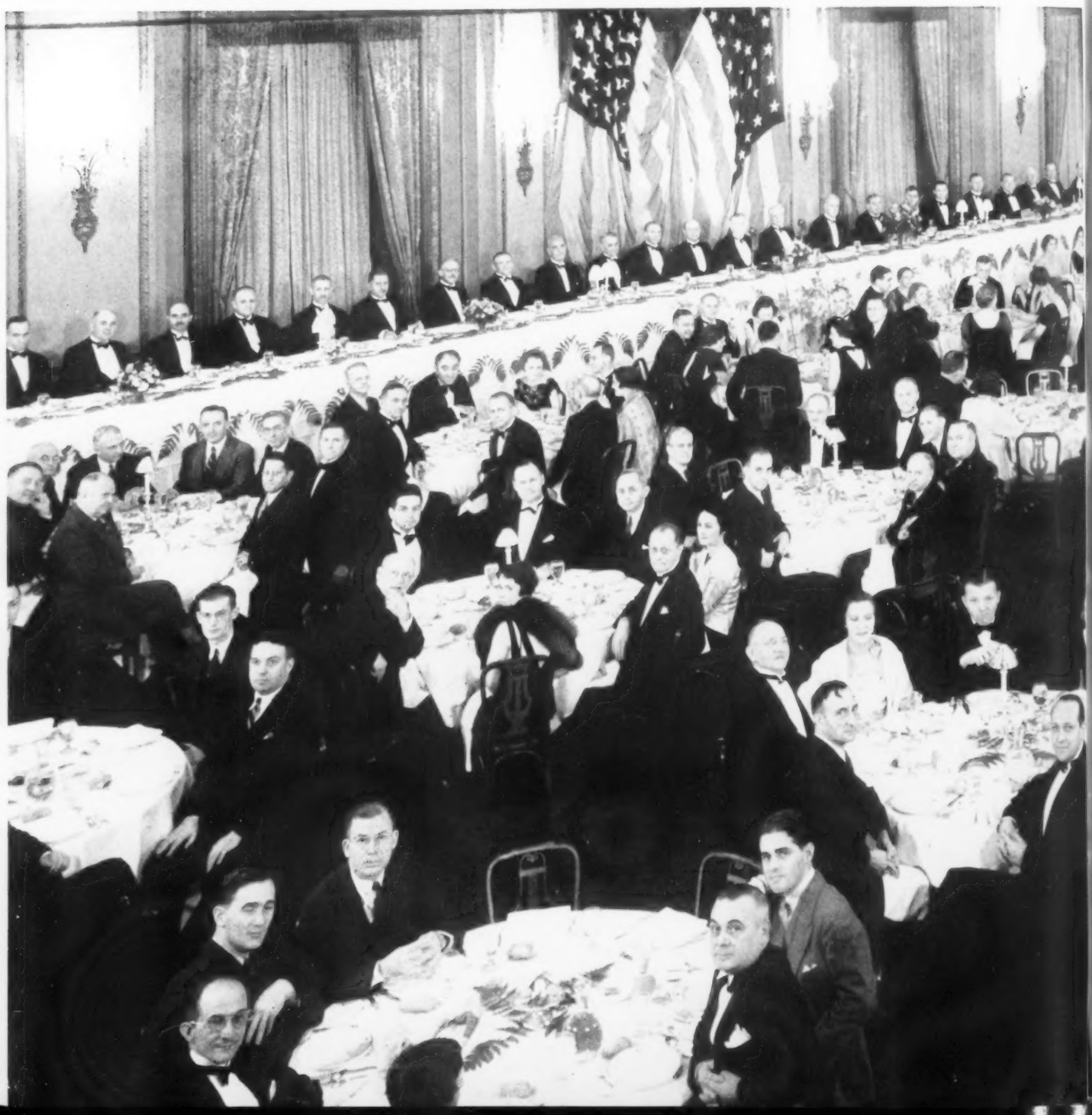
ONE of the most entertaining industrial exhibitions of recent years closed its doors last Friday after a five-day session. Registered attendance exceeded 15,000 and well over 30,000 visitors witnessed a glittering array of exhibits pertinent to the production, fabrication, welding, inspection and application of ferrous and non-ferrous metals. Over 160 separate booths were scattered over some four acres of floor space in Commerce Hall of the Port of New York Authority Building. The rented floor space surpassed by 40 per cent that of the Detroit exposition last year, thereby indicating to some extent that the trend of industrial sentiment is upward.

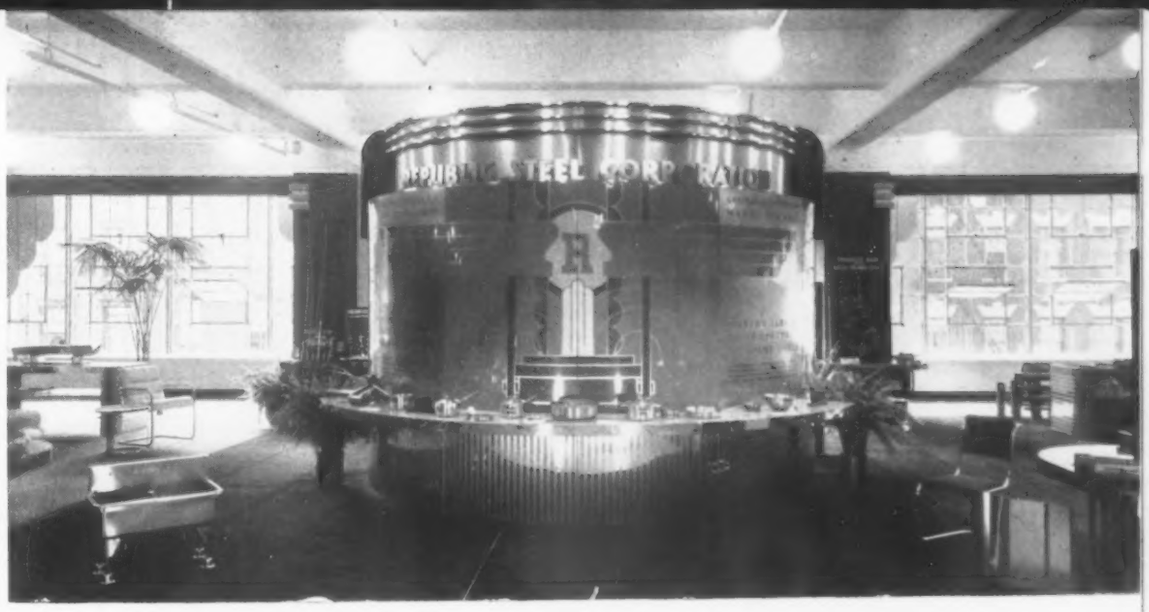
The dominant theme of the show was alloy steel—its multifold advantages in either cast or rolled form and its constantly expanding usage in consumer products. Stainless steel was in particular evidence in the form of murals, statues, etchings, and panelwork. Of the many booths of interest, seventeen selected at random are displayed on the following pages.

On the inside page there is reproduced a general view of the sixteenth annual dinner of the American Society for Metals, which was held in the Hotel Pennsylvania, Thursday, Oct. 4. The principal speaker was Republic Steel's president and board chairman, T. M. Girdler, who can be seen near the center of the speakers' platform. Near Mr. Girdler is Dr. Albert Sauveur, Gordan McKay Professor of Mining and Metallurgy at Harvard University, who was awarded the society's newly established Albert Sauveur Achievement Medal. In addition, John Chipman, of the University of Michigan, was announced as the winner of the Henry Marion Howe Medal, conferred annually on the author of the paper of highest merit published by the society. W. B. Coleman, of Philadelphia, was given the President's Medal as past-president of the society. W. H. Phillips, of Pittsburgh, the outgoing president, presided.

*Photos by Drucker & Baltes Co.*

A SECTION of the Bethlehem Steel Co. display was devoted to the manufacture of railroad car and locomotive wheels. Transparent colored photographs in the background and wheel samples mounted below showed the forming processes from the wheel block through the forging, rolling and coning operations to the finished wheel. Zinc coated Bethanized wire products were shown to the right.





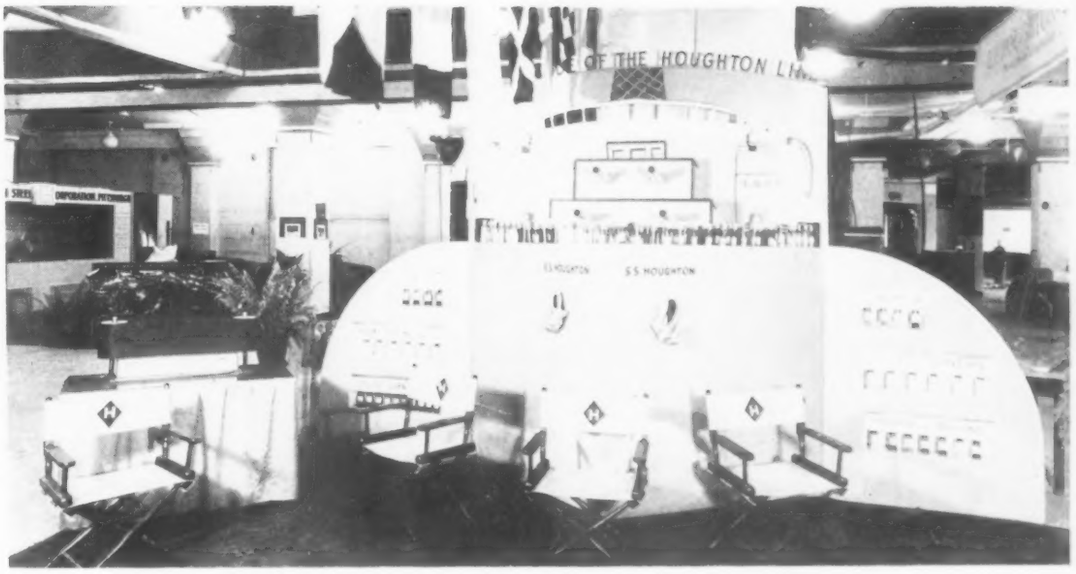
FOR magnitude and eye appeal the exhibit of the Republic Steel Corpn. was surpassed by none in the show. A circular room of enameled stainless steel was surrounded by displays of Enduro kitchen equipment, metal covered plywood, stainless nuts, bolts and screws, stainless beer barrels, and an assortment of gears and roller bearings. A new feature was a group of construction sections of Mo-Cu steel.

IN the foreground is a cast stainless steel bust of Katherine Cornell as exhibited by Joseph T. Ryerson & Son, Inc. A general line of welding rods, rolled sections and stainless steels were in evidence. A new product shown is long machine lengths of cast leaded phosphor bronze for forming into bushings and gear blanks.

IN the background is an automatic working scale model of a 2-high 40-in. blooming mill of the Jones & Laughlin Steel Corpn. Wooden ingots and billets were manipulated for the edification of visitors. Containers of J & L tin plate, piling sections, wire products and cold finished Jalcase steel products were also shown.

A MOTOR operated spot welder used in conjunction with an Ignitron welding timer was featured by Westinghouse Electric & Mfg. Co. Stainless and aluminum strips were joined for the visitors. Also displayed was a new Flexarc 500 amp. A.C. welder for heavy boiler work.

A SHIP'S bow carried a traveling display of oils, fluids and salts merchandized by E. F. Houghton & Co. A main feature of this booth was a working demonstration of Perliton liquid carburizer. Small steel samples were case hardened to a depth of 0.030 in. in about 2¾ hr. A fountain of Sta-Put high film strength oil was particularly attractive to the layman.



TITANIUM Alloy Mfg. Co. demonstrated its aluminum titanium Webbite as employed for refining grain size and degasifying aluminum castings. Special alloys and ceramic materials were on display as well as miscellaneous titanium treated iron and steel castings and rolled steels.

AT frequent intervals a Murex electric welding demonstration drew spectators to the booth of the Metal & Thermit Corpn. There was also an array of Thermit equipment and photographs of heavy mill equipment which was quickly restored to service after breaking by means of Thermit welds.

GRASSELLI Chemical Co., Inc., featured Cadalyte, a process and product for cadmium plating. Also included was a working test on inhibitors showing a method of determining acid contents of pickling solutions at any time. Acids, fluxes and assorted chemicals were also displayed.

THE United States Steel Corpn. showed its manifold products in three booths. Cor-Ten car sections and 18-8 stainless shot welded Budd sections were featured in the center display. In the distance is the unit of Carnegie Steel Co. where motion pictures and illuminated photographs were used to demonstrate carbon and grain size control.

TRANSPARENT photographs of actual plant grinding operations were of interest in the Norton Co. display. By means of a large magnifying glass visitors were able to examine the controlled difference in grain structure of all types of grinding wheels.

MURALS and manufacturer's products were used by the International Nickel Co. to demonstrate the usefulness of nickel in steel, cast iron, nickel silver, brasses and bronzes. Forgings and welding rods for joining nickel alloys were in evidence for examination. Ni-Resist, Inconel and Monel metal products also were displayed.

A UNIQUE process for hardening low-carbon steel was demonstrated by the Chapman Valve Mfg. Co. Products of various manufacturers who use a Chapmanizer were on display. In addition, polished and etched steel sections showing core structures and depth of Chapmanized cases were shown.

ALLEGHENY Steel Co. devoted its booth to tubing, chemical vats, etchings and consumer products of Allegheny metal. Punched grill work surrounding the booth was particularly attractive. Three-dimensional models in the background showed actual installations of Allegheny metal in dairies, hospitals and food handling plants.

TWO large murals portraying open-hearth and soaking pit operations received considerable attention in the section sponsored by the Great Lakes Steel Corpn. There was a revolving display of merchant mill products, and also a motion picture showing operations from ore mine to finished steel.

A GROUP of Steckel rolls of Motung (molybdenum - tungsten) steel was shown by Universal Steel Co. and Cyclops Steel Co. Hacksaw blades, drills, millers, hobs, etc., of the same material, were also featured. A surface hardness tester in operation demonstrated Motung hardness equal to that of high-speed steel.

CENTRIFUGALLY cast tubular cylinder liners of newly developed Nitricast-iron occupied a prominent place in the booth of the Forging & Casting Corpn. Other products available for examination were oil and air-hardening tool steels cast to shape and tool and mild steel composite die sections.

# Variety of Papers Is Presented To A.I.M.E. Congress

*Sponge Iron*

*Graphite in Low-Carbon Steel*

*Aging as Affected by High Hydrostatic Pressure*

*Aging Changes of Zinc-Alloy Die Castings*

*Age-hardening of Al-Ni Alloys*

*Directional Properties in Low-Carbon Steel*

*Composition and Properties of Die Casting Alloys*

THE five-day period which ended Oct. 5 was replete with events of particular interest to metallurgists of the American Insitute of Mining and Metallurgical Engineers. Of course the dominant theme of the New York meeting was the splendid technical program in which theory and practice were nicely balanced, as is evidenced by the following review of topics which were under discussion. However, the first National Metal Exposition ever held in New York was equally informative, and the great range of manufacturers' demonstrations was judged to be an education in itself.

One interesting paper was that of G. B. Waterhouse concerning the manufacture and properties of sponge iron. As is well known, in many metals such as zinc, the reduction of the ore is only secured by raising the temperature usually to a visible red or above. However, in the reduction of iron ore, expressed by the relation $Fe_2O_3 + 3CO = 2Fe + 3CO_2$, the temperature can be as low as 600 deg. C., and the product thereby obtained is called sponge iron. Of course the universally used blast furnace employs a temperature more than twice this figure, but the elevated temperature is not maintained to accelerate the reaction but is used to melt the slag and the reduced metal so that they may flow freely out of the furnace.

There have been numerous processes designed to produce in a dependable way a good grade of sponge iron. That is, it would be very valuable industrially to have a foolproof method of removing oxygen from the iron of iron ores by the use of low temperatures for the production of metallic iron instead of the present product, which is a mixture of iron with carbon, sulphur and other elements. Low-grade iron ore fines could thereby be utilized, a better grade of steel would result, and it is possible that a good process would be economically advantageous.

Mr. Waterhouse pointed out that the sponge iron which is currently produced cannot compete with scrap at present prices for use in ordinary steels. However, many steels require better raw material than much of the present scrap which is contaminated with copper, nickel, molybdenum, tin, arsenic and other alloying elements or impurities. For instance, there is difficulty in furnishing the deep-drawing sheet steels needed by the automobile and other industries, and in such cases sponge iron would be a very helpful ingredient of the charge. Sponge iron melts readily in the open-hearth or electric furnace, although it melts with less loss by oxidation if immersed promptly in a bath of metal or slag. As time goes on it undoubtedly will find its place as a pure raw material in the manufacture of the many steels having to meet stringent specifications such as forging and alloy steels.

Sponge iron as it is produced has roughly the size and shape of the pieces of iron ore from which it originated, and, as its name implies, it is porous in form. The low-temperature reduction is a complex process, and it is believed to take place in steps. The chief reducing agent employed is carbon monoxide which is oxidized to carbon dioxide. The various reactions are reversible so that the reduced oxides or the metal may be oxidized back again to oxide or to higher oxides. These actions have received considerable study and are known in detail.

### Different Processes Described

The reduction of iron ore by means of charcoal or solid carbonaceous material is often spoken of as direct reduction, while reduction with gases rich in carbon monoxide is called indirect reduction. A typical example of the first method is the Smith process, developed in this country, while good examples of the second are the Edwin and Wiberg processes, worked out in Norway and Sweden. Even in the first method much, if not all, of

the reduction is brought about by carbon monoxide.

The Smith process is carried out in vertical retort ovens very similar in construction to the Semet-Solvay by-product coke ovens, heated by means of horizontal flues. The mixture of ore and carbonaceous material is charged at the top and discharged at the bottom. As the mixture descends slowly, it is first preheated, then raised to the proper reduction temperature of 1700 deg. F. to 2000 deg. F., and finally cooled before being discharged.

Mr. Waterhouse continued by describing the Edwin process, which depends on the reduction of crushed preheated ore in a rotary kiln by gas rich in carbon monoxide. From the reducing chamber the material passes to a cooling chamber and when cold is withdrawn, crushed and magnetically separated into sponge iron, intermediate product and gangue. The intermediate product is returned to the system. The reducing gas is produced from coke in a special electrically heated generator to which is returned the cleaned, washed gas from the reducing chamber. The excess gas, beyond what is needed for reduction, is drawn off and used for preheating the ore.

The Wiberg process uses the same general principles as the Edwin process. A vertical rectangular shaft is used, although a series of rotary kilns can be employed. Part of the reducing gases are withdrawn about halfway up the shaft, cleaned and passed to an electrically heated regenerator or gas producer, charged with charcoal or coke for the regeneration of carbon monoxide. About three-quarters of the way up the shaft air is introduced through nozzles, which burns the remainder of the reducing gases and serves to preheat the ore. The reduced ore is withdrawn from both sides at the bottom of the shaft, crushed and concentrated.

After being reduced by these or other processes. the sponge iron is generally crushed, magnetically concentrated and briquetted to put it into suitable shape for storage, shipment and handling.

Sponge iron varies from light gray to dark gray in color. It is friable and spongy, and because of this porosity is light in weight. It can be compressed, and forms hard blocks or briquettes, depending on the pressure used, and can be easily produced with a specific gravity of about 4.0. It is strongly magnetic because of the magnetic properties of the individual iron particles, and can therefore be readily concentrated. The degree of concentration depends, however, on the fineness of intermixture with the original gangue minerals of the ore, because sponge iron is not a uniform homogeneous material. It consists of iron, oxide or oxides of iron, and the remaining gangue of the ore. Each ore is a particular problem and study. In some cases the product is close to 100 per cent metallic iron, because of the purity of the ore or the richness of the concentrates used; in others, it is not possible or feasible to concentrate the ore, and the reduced material is still high in mineral matter and fairly low in iron.

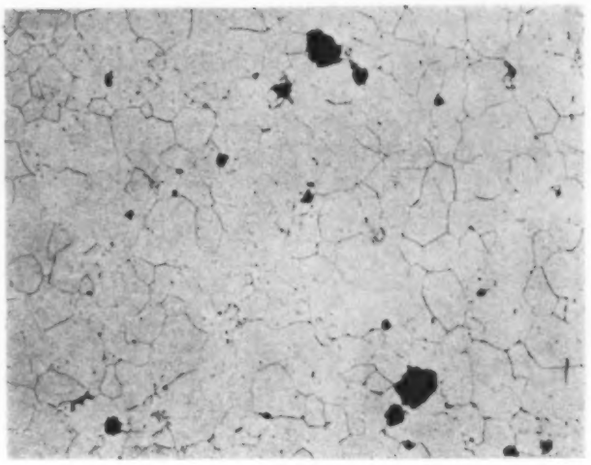


FIG. 1.—Microstructure of low-carbon still tube after three-year service. Sample taken about 6 ft. from firing end of still. At 100 diameters.

Sponge iron chemically is an active material and is very readily oxidized. A piece of reduced ore may be lighted with a match and will glow or burn and be changed back to oxide. As freshly made it exposes a large surface, so that it is best to compress or briquette it for storage or shipment. Its melting point is high, approaching that of pure iron, but as usually made it contains carbon, in some cases up to 0.5 per cent or higher. It usually contains oxide of iron, due either to incomplete reduction or to formation of oxide after reduction. If discharged from the reduction ovens or retorts too hot, it will smoulder and change back to oxide very quickly. These properties should be borne in mind in the following discussion of uses.

The chemical activity of sponge iron and the possibility of obtaining it in a fine state of division, or to compress it into desired sizes, outline uses in many fields. It may be used to precipitate copper and lead from solutions and, therefore, be an active agent in the hydrometallurgy of these two metals. This is discussed in detail in the Bureau of Mines Bulletin 270. There are other applications in similar fields, which may all be classed as chemical engineering fields, such as the hydrogenization of oils, the making of dyes, etc., which may use a considerable tonnage. Powdered sponge iron may be incorporated with ordinary cement into special concrete mixtures, which are very hard. It can be used, also, as the source of iron. One automobile company has already made 7,000,000 parts from sponge iron this year.

## Sponge Iron Important in Steel Industry

The most important uses would seem to be in the iron and steel fields. Considerable experimental work has been done on the production of commercial products direct from sponge iron by compressing it in dies or between rolls, heating this material to the proper temperature and then forging or rolling to the required shape. The final properties will be similar or superior to those of wrought iron, malleable cast iron or certain mild steels, and the costs of production should be considerably less. It probably is best to start with very pure iron ores or with very rich concentrates, and at no time is a temperature needed high enough to melt the material. A modification of this process is to compress the sponge iron, or a mixture or combination of powdered metals, to shape, raise to a sintering and forging temperature and finish by an operation similar to drop forging.

In the usual fields of iron and steel metallurgy sponge iron must be considered as a raw material and compared with the other available materials. In concluding his review of uses Mr. Waterhouse pointed out that sponge iron can replace high-grade scrap or expensive wrought iron in the manufacture of tool steels and alloy steels by the crucible and electric furnace methods. The details of the superiority of such steels with a sponge iron base were shown by a

number of electric furnace heats described by W. Rohland in *Stahl und Eisen*, 1929, 49, 1477. A considerable tonnage of sponge iron is being imported from Norway and Sweden (over 700 tons from all countries for first half of 1934) for use in high-grade steels which so far have given excellent results. Additional evidence to this effect was given in a recent Bureau of Mines paper on carbon tool steel made from 50 per cent sponge iron and 50 per cent scrap as compared with all scrap. The sponge-iron steel had superior properties. It is also reported that the automobile industry is using sponge iron as a raw material in the manufacture of spring steels or other steels required to be highly resistant to fatigue.

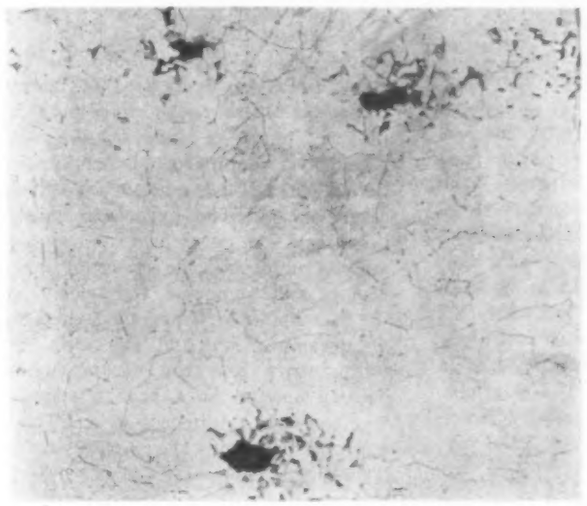


FIG. 2.—Microstructure of sample of Fig. 1 after heating 5 min. at 850 deg. C. At 100 diameters.

An entirely different subject than sponge iron was considered in another paper by A. B. Kinzel and R. W. Moore which invited considerable comment inasmuch as striking evidence was presented showing graphite formations in low-carbon steel. Such a conclusion had previously been predicted from general theoretical considerations, but the authors were particularly successful in their efforts to show that the truly stable phase in the iron-carbon system at tempertures below the eutectoid is in reality graphite instead of cementite. This conclusion is considered valid in view of the impurities contained in the experimental samples. There is a slight possibility that the results may have to be modified some time in the future for the pure iron-carbon system, although the low silicon content together with low values for the other elements in the author's samples makes the need for such modification seem improbable.

In speaking of their experiments the authors pointed out that although the iron-carbon diagram has undergone many changes in the last 20 years, the region below the eutectoid line and up to approximately 1.7 per cent carbon has been little affected. Graphite has been noted occasionally in the hypereutectoid steel region, and the ready formation of graphite nodules in malleable cast iron is a phenomenon difficult to interpret in the light of cementite, supposedly stable at subeutectoid temperatures. In this case the graphite formation has been partly explained by the presence of silicon, and many believe that silicon acts to change the stable state rather than to accelerate reactions so as to arrive at the stable state in a briefer period of time. Consideration of this phenomenon indicates that cementite is not the stable phase in the temperature composition zone referred to.

The authors obtained clues which shed light on this entire subject in the course of examining a low-carbon steel tube taken from a petroleum cracking still which had been used about three years at a temperature somewhat below the eutectoid. The tube analyzed the same when purchased as after the three years' service, namely, 0.15 per cent carbon, 0.49 manganese, 0.02 silicon, 0.023 sulphur and 0.015 phosphorus. The microstructure of this tube after service is shown in Fig. 1, and from this view it is evident that cementite as such is absent and that in its place nodular graphite has been formed. In order to check this observation further, samples taken from the tube were heated at 850 deg. C. for varying periods of time. The small samples were put into a hot furnace and readings of total time were recorded. The structure of the sample after 5 min. at 850 deg. C. is shown in Fig. 2. In this view the nests of pearlite surrounding the graphite nodules are most satisfactory evidence of the character of the nodules.

The authors continued by stating that as the length of time of heating at 850 deg. continued, the pearlitic zone increases with final restoration of the pearlitic structure as would be expected to exist in normalized steel of this carbon content. This is illustrated in Fig. 3, where the sample has been heated for 15 min. at 850 deg. C. The authors concluded with the information that during the course of examining a number of tubes that had had various lengths of service, it was possible to find spheroidized structures, and spheroidized and partly graphitized structures. Such observations are in agreement with the general concept of the mechanism of graphite formation.

## High Pressure Decreases Aging Rate

Both ferrous and non-ferrous alloys which are freshly produced are undoubtedly not at equilibrium and after fabrication certain changes are apparent until an ultimate state of equilibrium is reached. As this phenomenon is the chief cause of changes in dimensional and physical properties of die casting alloys, it is only natural that considerable experimental work be devoted to it in order to determine the mechanism of the process

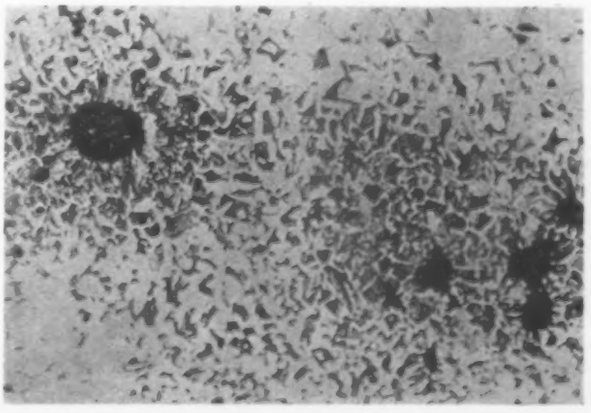


FIG. 3.—Microstructure of sample of Fig. 1 after heating 15 min. at 850 deg. C. At 100 diameters.

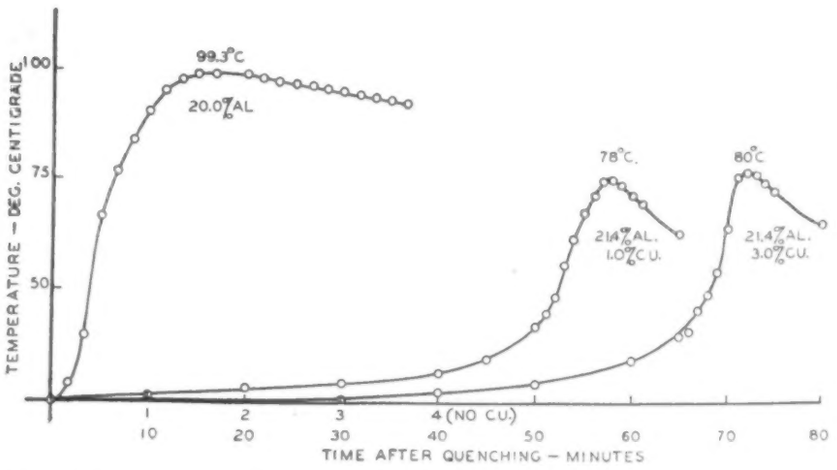



FIG. 4.—Rate of decomposition of beta phase of zinc-aluminum die casting alloy immediately after quenching. The retarding effect of copper is clearly shown in the above curves. ▲ ▲ ▲

and the various controllable factors which influence the rate of aging.

One paper was of value in that it determined qualitatively and somewhat quantitatively the influence of high hydrostatic pressures on the rate of aging. Leland Russell van Wert, of Harvard University, described experiments wherein he subjected a variety of ferrous and non-ferrous alloys to pressures up to 12,000 atmospheres. This pressure-aging was carried on at P. W. Bridgeman's laboratory, from which much notable work has come in the field of the physics of high pressures.

The choice of age-hardening alloys for this study was made on the basis of securing as wide a range as possible in the compressibility of the solvent metal. The alloys selected included commercial duraluminum, aluminum-copper alloy containing 0.17 per cent calcium as an aging inhibitor but otherwise essentially the same as duraluminum, alloy P-141, which is an aluminum alloy containing nominally 1 per cent silicon, 0.6 per cent magnesium and 0.5 per cent iron, alloy P-148, which is a complex aluminum alloy containing nominally 10 per cent zinc, 1 per cent copper, 0.7 per cent iron, 0.8 per cent silicon, 0.75 per cent manganese and 0.4 per cent magnesium, a lead-calcium alloy containing 0.04 per cent calcium, and iron-nitrogen alloy containing 0.07 per cent nitrogen. The lead-calcium alloy is an example of an age-hardenable alloy with a highly compressible solvent metal; the four aluminum alloys represent cases of a solvent metal of moderate rigidity, whereas the iron-nitrogen alloy is one whose base metal is but slightly compressible.

The experimenter described his procedure as follows: each alloy was solution annealed at the proper temperature for the time necessary to insure complete solution of the precipitant. It was then quenched in water. The Rockwell hardness was immediately taken. The alloy was permitted to age at room temperature, with one series at ordinary pressure and a similar series at about 12,000 atmospheres pressure. After aging for definite time periods, hardness tests were again made.

The author described his results in the Society for Metals paper as follows: A pressure of 20,000 atmospheres failed to lower to any detectable degree the aging rate of the iron-nitrogen alloy; the other alloys showed a definite inhibition of aging rate due to the high pressure. For all the alloys the final hardness was not affected by the pressures, only the time necessary to attain this hardness. In general, the greatest effect of pressure is experienced by the alloys of greatest compressibility. This would indicate, seemingly, that pressure's effect on aging rate comes about through changes in the "viscosity" of the metastable solid solution, thereby influencing the diffusion rate of the age-hardenable elements through the latter's lattice.

The actual experimental results on three alloys are shown in Tables 1 to 3. Table 1 shows the aging inhibition of pressure for the lead-calcium alloy which has a highly compressible solvent metal; Table 2 indicates the results on a representative aluminum alloy with a moderately compressible solvent metal, and Table 3 shows the results obtained with the iron-nitrogen alloy whose base metal is practically incompressible.

## Zinc-Alloy Die Casting Shrinkage Studied

Additional aging data was presented by M. L. Fuller and R. L. Wilcox of the New Jersey Zinc Co. In this investigation the authors dealt with the beta phase in zinc-alloy die castings and attempted to determine the period of existence of the beta phase after casting. The pure beta constituent and its decomposition are examined in detail, the effect of magnesium and copper on the velocity of the decomposition is reported, the heat of decomposition and the eutectoid temperature and the accompanying density change have been measured. The possible influence of the beta decomposition on the shrinkage in freshly cast zinc-alloy die castings is estimated.

Partly because of their commercial importance and partly because of their great scientific interest, the zinc-aluminum alloys, particularly the beta phase, have been the subject of many papers. On account of the marked inhibiting effects of copper and magnesium (one or the other or both of which are present in modern zinc die-casting alloys) it has been generally considered that the beta phase decomposed more slowly in die castings than a number of X-ray studies showed. The present authors, therefore, de-

TABLE 1

**Aging of Lead-Calcium Alloy (0.04 Per Cent Calcium) Under a Pressure of 1 Atmosphere and Under 12,000 Atmospheres**

| | Hardness (Rockwell "S-M")* | | | |
|---|---|---|---|---|
| | Immediately | After Aging 5 Hr., Under | | Hardness After 5 Additional Hours |
| Sample | After Quenching | 1 Atmosphere | 12,000 Atmospheres | at 1 Atmosphere |
| 1-A (Swaged) | 8.4 | 57.5 | ... | ... |
| 2-A (Swaged) | 6.8 | 50.8 | ... | ... |
| 1-B (Swaged) | 8.3 | ... | 11.2 | 56.3 |
| 3-A (Cast) | 2.6 | 51.7 | ... | ... |
| 3-B (Cast) | 1.9 | ... | 8.7 | ... |

*¼ inch penetrator, and 30 kilogram load.

cided to study the beta decomposition further and a series of aluminum-zinc alloys with various copper and magnesium contents were prepared for the work.

A pure beta alloy (80 per cent Zn, 20 Al), containing no inhibitor, decomposed in 1½ min. and attained a maximum temperature of 99.3 deg. C. from an initial temperature of 20 deg. C. Of course the time required to reach a maximum temperature is generally assumed to be coincident with the time to effect a complete decomposition. The data was obtained simply by measuring the spontaneous rise in temperature immediately after quenching. The alloy containing 1 per cent copper decomposed in 58 min., and the alloy containing 3 per cent copper took 72 min. for the beta phase to decompose. All this data is plotted in Fig. 4, and it is very evident from the curves to estimate the great retarding effect of copper. Subsequent X-ray examinations showed that the beta had truly been decomposed and the single-phase beta had become a mixture of alpha and gamma.

The large increase in density that accompanies the beta decomposition makes it possible to follow the course of the change by dimensional measurements. The present authors examined an alloy containing magnesium as an inhibitor by the conventional dilatometer manner. The results of this experiment are shown graphically in Fig. 5.

It is assumed that the time for maximum shrinkage is coincident with the time for complete decomposition (disregarding possible shrinkage effects due to changes in alpha or gamma). The beta completely decomposed after about seven weeks at room temperature or 100 min. at 100 deg. C. These reaction times are in agreement with the X-ray results. The shrinkage (0.29 per cent) resulting from the decomposition of beta was found to be the same after room temperature aging as after 100 deg. C. aging, within the limits of error.

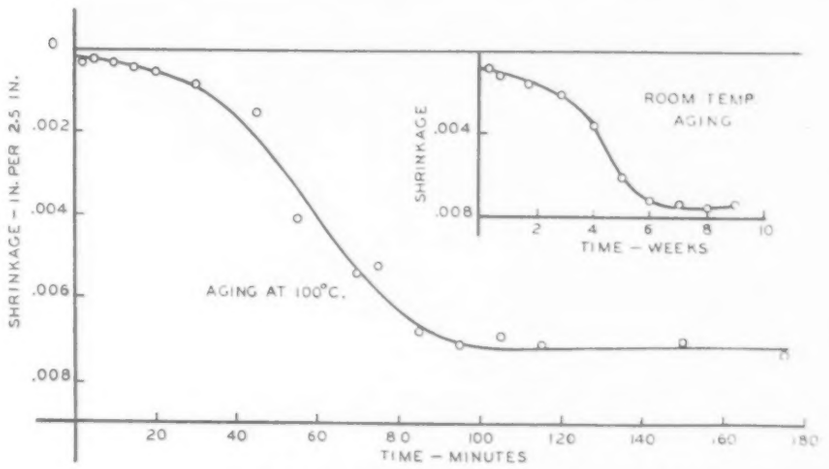



FIG. 5.—Aluminum-zinc die casting alloy with 0.1 per cent magnesium as an aging inhibitor. The rate of decomposition of the beta phase is indicated in the shrinkage curves above.

The experiments of the authors could be summed up in (1) that magnesium and copper greatly retard the beta aluminum-zinc decomposition into alpha and gamma, (2) the beta constituent decomposes much more rapidly in zinc-alloy die castings than in single-phase beta alloys quenched from a temperature of beta stability. Thus in an alloy containing magnesium but no copper, the beta, if present, decomposes in less than one day. In an alloy containing copper and magnesium the beta is definitely present in fresh castings but decomposes in less than one week, and (3) the shrinkage resulting from the decomposition of a single-phase beta alloy is 0.29 per cent. Expressed in the terminology of the die casting technologist, the shrinkage is 0.017 in. in 6 in. (the customary length of test bars).

The authors measured the increase in density or the shrinkage accompanying the beta decomposition and found that their figures were consistent with the shrinkage calculated from crystal-structure data. It was also determined that the beta decomposition cannot be the sole cause of the aging shrinkage in die castings. Other phase changes contribute to the shrinkage phenomenon, and these changes will be the subject of a future paper by the authors.

Crystallographically, beta is identical with gamma. Both show face-centered cubic structure with identical relative line intensities in their X-ray powder diffraction patterns, differing only in lattice dimensions. The authors, in an X-ray study of the aging of the beta in the sample containing magnesium as inhibitor, found that the initially coarse-grained beta decomposed into fine-grained alpha and coarse-grained gamma. Fig. 6 shows the typical structure developed in the aging of beta containing the inhibitor magnesium, a structure too fine for crystallographic analysis.

The X-ray evidence on the relation of the eutectic to the parent beta crystals as presented above by the authors is not compatible with the previously quoted theory of Schwarz and Summa. By their theory the products of the decomposition of coarse-grained beta would be coarse-grained alpha and fine-grained gamma, whereas the experimental evidence presented above shows that the reverse is true.

Another paper dealing with age hardening was presented by W. L. Fink and L. A. Willey of the Aluminum Research Laboratories; the subject under study was high-purity aluminum-nickel alloys, and it was shown that these alloys are particularly susceptible to age-hardening, as would be suspected in that the per-

TABLE 2

Aging of Duralumin Under a Pressure of 1 Atmosphere and Under 12,000 Atmospheres

| Sample | Hardness (Rockwell "E")* Immediately After Quenching | After Aging 24 Hr., Under 1 Atmosphere | After Aging 24 Hr., Under 12,000 Atmospheres | Percentage Increase in Hardness in 24 Hours |
|---|---|---|---|---|
| 1-A | 83.0 | 99.7 | ... | 20.0 |
| 1-B | 83.0 | ... | 90.5 | 9.0 |
| 2-A | 81.2 | 99.1 | ... | 22.0 |
| 2-B | 81.0 | ... | 91.1 | 11.2 |
| 3-A | 82.1 | 98.9 | ... | 20.4 |
| 3-B | 82.6 | ... | 91.7 | 10.7 |
| 4-A | 80.6 | 97.6 | ... | 21.1 |
| 4-B | 80.4 | ... | 90.4 | 12.4 |

*1/8 inch penetrator and 100 kilogram load.

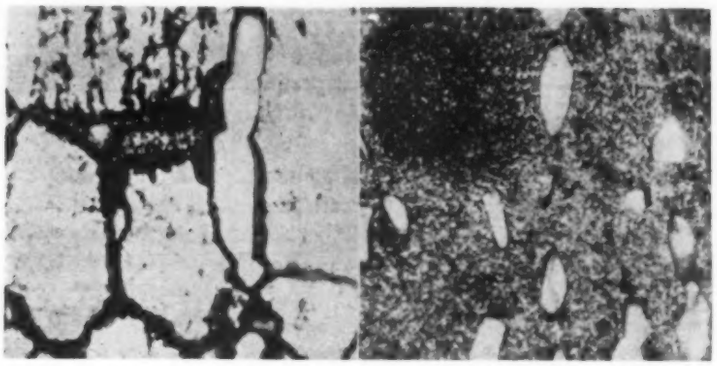


FIG. 6.—Aluminum-zinc die casting alloys quenched from 325 deg. C. and allowed to age at room temperature. Alloy contains 0.1 per cent magnesium as an inhibitor. To the left is shown the structure after three weeks aging and to the right after nine weeks aging. At 1000 diameters.

centage variation of the solubility of nickel in aluminum with temperature is large, even though nickel is only slightly soluble in solid aluminum. The authors examined a series of alloys (0.01 to 0.19 per cent nickel) and gave the samples heat treatments suggested by the solid solubility curves previously determined. Substantial age-hardening was found as exemplified by the fact that the Brinell hardness number (12.61 Kg., 1.59 mm. ball) of the 0.03 per cent nickel alloy was 17.7 after heating at 625 deg. C. and water quenching. After the same specimens had been artificially aged for 8 hr. at 265 deg. C. the Brinell hardness number had increased to 26. Fig. 7 shows the hardness concentration curves for the entire series of alloys after the same thermal treatments.

Two aging temperatures were investigated, namely, 200 deg. and 265 deg. C. Age-hardening takes place at 200 deg. C., but a maximum value of hardness is not attained even after 60 hr. at this temperature, whereas a maximum is reached in from 15 to 20 hr. at 265 deg. C. For the 0.01 per cent nickel alloy only a slight increase in hardness was found to occur over even a very long period of time.

## Carbon Steel Strength Varies With Rolling Direction

Another interesting paper concerned itself with directional properties of cold-worked and annealed low-carbon steels. The authors, A. Phillips and H. H. Dunkle of Yale University, have shown in previous papers that brass and copper vary considerably with regard to their tensile strength when tests are made at various angles to the direction of rolling.

The material under test in the present investigation analyzed carbon 0.09 per cent, manganese 0.40, phosphorus 0.008 and sulphur 0.028 per cent. Mechanical tests were performed on specimens cut at 0, 22.5, 45, 67.5 and 90 deg. to the rolling direction. The results for material given heavy reductions prior to the annealing treatment show a maximum in tensile strength and a minimum in elongation at about 45 deg.

The general object of the experiments was to furnish a desirable compilation of mechanical properties showing the significance of fiber effects produced by a diversified schedule of working and heat treatment which would in addition serve as a statistical background for a proper evaluation of X-ray studies on fibered materials.

For the hot-rolled strip, tensile and elongation tests were made on specimens representing five directions, viz., 0, 22.5, 45, 67.5 and 90 deg. to the axis of rolling. The results of these tests are summarized in Table 4. The maximum variation in tensile strength of the several strips was found in the material rolled to 0.053 in., i.e., the steel having the greatest reduction. In this case the transverse strength was found to be some 6 per cent greater than that of the longitudinal specimens. The corresponding difference in the material rolled to 0.065 in. was only about 3 per cent.

For testing the directional properties of cold-rolled strip, a number of the samples were pickled and then

TABLE 3

**Aging of Iron-Nitrogen Alloy (0.07 Per Cent Nitrogen) Under a Pressure of 1 Atmosphere and Under 20,000 Atmospheres**

| | Hardness (Rockwell "B") | | | |
|---|---|---|---|---|
| | Immediately | After Aging 3 Hr., Under | | Percentage Increase in Hardness in 3 Hours |
| Sample | After Quenching | 1 Atmosphere | 20,000 Atmospheres | |
| 1-A | 85.9 | 99.7 | ... | 16.0 |
| 1-B | 84.8 | ... | 99.5 | 17.3 |

TABLE 4

**Properties of Hot-Rolled Steel as Related to Rolling Direction**

| Hot-Rolled to In. | Rockwell B-Scale | Tensile Strength, Lb. per Sq. In.* | | | | | Elongation in 2 In., Per Cent* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0° | 22.5° | 45° | 67.5° | 90° | 0° | 22.5° | 45° | 67.5° | 90° |
| 0.103 | 60 | 53,000 | 52,250 | 52,250 | 52,200 | 52,000 | 34.0 | 32.8 | 31.8 | 31.5 | 29.3 |
| 0.079 | 59 | 52,300 | 52,700 | 52,750 | 52,500 | 52,800 | 35.0 | 35.5 | 35.5 | 33.0 | 32.0 |
| 0.065 | 55 | 49,900 | 49,620 | 49,680 | 50,730 | 51,280 | 33.5 | 33.5 | 35.5 | 32.0 | 33.0 |
| 0.053 | 59 | 51,080 | 52,250 | 51,520 | 51,900 | 54,160 | 31.5 | 31.0 | 33.0 | 31.0 | 29.0 |

*Average value of three tests.

TABLE 5

**Properties of Cold-Rolled Steel as Related to Rolling Direction**

| Series | Reduction | | Rockwell B-Scale | Tensile Strength, Lb. per Sq. In. | | | | | Elongation in 2 In., Per Cent | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Actual-In. | Per Cent | | 0° | 22.5° | 45° | 67.5° | 90° | 0° | 22.5° | 45° | 67.5° | 90° |
| 1 | 0.053 to 0.043 | 40 | 84 | 87,350 | 88,800 | 90,500 | 95,650 | 98,550 | 2.0 | 2.5 | 3.0 | 3.0 | 2.5 |
| 2 | 0.065 to 0.032 | 50 | 87 | 94,500 | 95,850 | 97,900 | 103,000 | 106,000 | 1.5 | 1.5 | 2.0 | 1.5 | 1.5 |
| 3 | 0.079 to 0.032 | 60 | 91 | 101,000 | 105,100 | 102,500 | 109,000 | 111,350 | 2.0 | 1.75 | 2.0 | 2.0 | 2.0 |
| 4 | 0.103 to 0.032 | 69 | 94 | 114,700 | 123,450 | 118,500 | 122,500 | 125,700 | 1.75 | 1.5 | 1.5 | 1.5 | 2.0 |

cold-rolled to a common gage of 0.032 in. As the original samples were of varying thickness, the reductions were found to be 40, 50, 60 and 69 per cent. Tensile tests were made on these samples in the five directions with respect to the rolling axis. The results are shown in Table 5.

In general, it may be stated that, in all cases, the transverse strength is the greatest; furthermore, the strength values increase progressively from the 0. to the 90-deg. positions, with the exception that a peak is evident in the 22.5-deg. direction in the strips reduced 60 and 69 per cent. The transverse strength is some 10 to 12 per cent greater than the longitudinal. Moreover, the percentage difference does not seem to be a function of the degree of cold-working within the range of reductions studied.

After testing the cold-rolled samples, each of the specimens were annealed at various temperatures. In each heat treatment the material was brought with the furnace to temperature, heated for 2 hr., after which the metal was furnace cooled to ordinary temperatures. All heating and cooling was carried on in an atmosphere of producer gas. The results of the hardness and tensile tests made on these annealed samples are shown in Table 6.

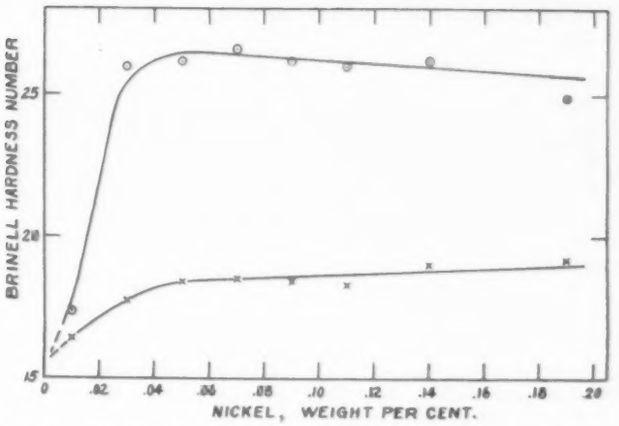



FIG. 7.—Age-hardening of aluminum-nickel alloys of various compositions. Alloys for upper curve were heat treated at 625 deg. C., and for lower curve the alloys were heat treated at 265 deg. C. and aged 8 hr. at 265 deg.

TABLE 6

Properties of Annealed Steel as Related to Rolling Direction

| Reduction, Per Cent | Temperature of Anneal Deg. C. | Tensile Strength, Lb. per Sq. In. | | | | | Elongation in 1 In., Per Cent | | | | | Rockwell B-Scale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0° | 22.5° | 45° | 67.5° | 90° | 0° | 22.5° | 45° | 67.5° | 90° | |
| 40 | 680 | 48,600 | 49,700 | 50,100 | 50,900 | 51,000 | 47.0 | 42.0 | 41.0 | 44.5 | 40.0 | 48 |
| 40 | 705 | 49,000 | 49,400 | 50,200 | 51,500 | 51,300 | 37.0 | 38.0 | 41.0 | 41.5 | 42.0 | 45 |
| 40 | 720 | 49,800 | 49,900 | 51,100 | 51,750 | 52,500 | 37.0 | 40.0 | 38.5 | 41.5 | 38.0 | 46 |
| 40 | 745 | 47,800 | 50,300 | 50,400 | 51,000 | 51,500 | 40.5 | 39.0 | 39.0 | 42.0 | 37.5 | 46 |
| 50 | 680 | 46,500 | 50,600 | 52,000 | 52,000 | 52,450 | 46.0 | 38.0 | 41.0 | 41.0 | 42.0 | 48 |
| 50 | 705 | 47,500 | 49,900 | 51,600 | 52,300 | 51,450 | 45.0 | 37.0 | 39.0 | 41.5 | 44.0 | 49 |
| 50 | 720 | 47,900 | 50,700 | 52,200 | 52,900 | 53,100 | 42.0 | 38.0 | 39.0 | 43.0 | 44.0 | 48 |
| 50 | 745 | 48,000 | 52,200 | 54,300 | 54,600 | 54,000 | 39.0 | 38.0 | 38.0 | 37.0 | 37.0 | 48 |
| 60 | 680 | 49,700 | 51,700 | 52,600 | 52,700 | 52,000 | 40.0 | 41.0 | 42.0 | 45.0 | 45.0 | 52 |
| 60 | 705 | 48,200 | 51,400 | 52,700 | 53,000 | 52,300 | 44.0 | 43.0 | 37.0 | 42.0 | 44.0 | 50 |
| 60 | 720 | 49,800 | 52,200 | 53,500 | 53,600 | 52,600 | 45.0 | 43.5 | 38.0 | 38.0 | 43.0 | 51 |
| 60 | 745 | 49,500 | 52,000 | 52,600 | 52,400 | 51,400 | 43.0 | 41.0 | 36.0 | 40.0 | 43.0 | 50 |
| 69 | 680 | 50,900 | 51,800 | 52,800 | 52,400 | 51,600 | 45.5 | 44.0 | 41.0 | 41.0 | 46.0 | 52 |
| 69 | 705 | 49,300 | 51,400 | 52,600 | 52,200 | 50,700 | 48.0 | 45.0 | 42.5 | 42.0 | 47.0 | 52 |
| 69 | 720 | 50,200 | 51,600 | 52,500 | 52,600 | 51,600 | 46.0 | 40.0 | 35.5 | 41.0 | 49.5 | 52 |
| 69 | 745 | 50,000 | 51,600 | 52,400 | 51,600 | 50,500 | 45.5 | 42.0 | 34.0 | 36.0 | 46.0 | 50 |

TABLE 7

Composition and Properties of Common Die Casting Alloys

| Composition, Per Cent | | | | | | | Yield Point | Ultimate Strength | Per Cent Elongation | Per Cent Reduction Area | Rockwell | Porosity Per Cent |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cu | Pb | Sn | Al | Fe | Si | Zn | | | | | | |
| 60.90 | ... | ..... | ..... | .. | ... | 39.1 | 36,650 | 59,950 | 19.44 | 25.53 | 49 | 70 |
| 60.30 | 0.20 | ..... | ..... | .. | ... | 39.5 | 34,150 | 49,350 | 8.17 | 19.40 | 49 | 10 |
| 60.88 | 0.43 | ..... | ..... | ... | ... | 38.69 | 37,900 | 44,400 | 3.75 | 11.52 | 57 | 10 |
| 58.68 | 0.52 | ..... | ..... | 0.20 | 0.40 | 40.2 | 41,500 | 57,650 | 1.48 | 6.40 | 76 | 10 |
| 59.80 | 0.78 | ..... | ..... | ... | ... | 39.42 | 34,800 | 43,250 | 3.75 | 11.45 | 60 | 60 |
| 59.24 | 1.15 | ..... | ..... | ... | ... | 39.61 | 37,850 | 48,050 | 3.98 | 11.36 | 57 | 10 |
| 61.20 | ... | ..... | ..... | 0.20 | 0.40 | 38.00 | 40,500 | 67,100 | 14.40 | 23.80 | 68 | 40 |
| 59.26 | ... | 0.50±0.05 | ..... | ... | ... | Remainder | 41,400 | 62,350 | 9.10 | 13.95 | 66 | 30 |
| 61.40 | ... | 0.50±0.05 | ..... | 0.20 | 0.40 | " | 41,150 | 65,850 | 8.40 | 17.10 | 66 | 30 |
| 58.92 | ... | ..... | 0.50±0.05 | .. | ... | " | 34,450 | 64,400 | 7.97 | 12.80 | 71 | 50 |
| 58.38 | ... | ..... | 0.50±0.05 | 0.20 | 0.40 | " | 39,300 | 54,600 | 0.86 | 5.10 | 76 | 50 |
| 58.90 | ... | ..... | 1.00±0.05 | ... | ... | " | 36,400 | 66,950 | 6.17 | 11.18 | 75 | 40 |
| 59.78 | ... | ..... | 1.00±0.05 | 0.20 | 0.40 | " | 46,150 | 67,100 | 4.21 | 6.47 | 75 | 40 |
| 61.72 | 0.88 | 0.50±0.05 | ..... | 0.20 | 0.40 | " | 41,700 | 53,700 | 5.80 | 11.10 | 56 | 30 |

With respect to the tensile properties of the strip annealed after the lowest reduction (40 per cent) it is interesting to note that, although the strength values have markedly decreased as would be expected, the data in general is similar to that for the cold-worked materials, in that there is a more or less progressive increase in strength from the 0 to 90-deg. positions. In other words, the type of fiber induced by cold-working has persisted after the annealing treatments. The anneals following the 50 and 60 per cent reductions tend to shift the maximum tensile strength value from the 90 to the 67.5 and 45 deg. directions. In the case of the anneals subsequent to the 69 per cent reduction, however, there is a decided maximum at the 45-deg. position. The elongation values, on the other hand, for the 69 per cent reduction reach a minimum value in the neighborhood of the 45-deg. direction. It does not seem wise to attempt to correlate the minor differences in properties with the heat treatments for a given reduction. It is quite probable that the slight irregularities in treatment almost unavoidable in a mill program may be responsible for greater differences within the group than may be properly attributed to the planned heat treatments within the annealing range considered.

The results obtained on the steels above can be compared with data previously obtained for copper and brass. In similar experiments on these metals, the authors have found that copper and 90-10 brass have shown a steady increase of strength from the 0 to the 90-deg. directions. The transverse strength of severely rolled (90 per cent reduction) tough-pitch copper is only approximately 3 per cent greater than in the longitudinal direction; in 90-10 brass, reduced 95 per

cent, the transverse superiority was found to be about 17 per cent.

### Properties of Die Casting Metals Described

In the development of the process of die casting or "pressure casting" of brass, many different metal compositions have been tried. This has resulted in widely divergent claims by different authorities as to the effects of small amounts of this or that element upon properties. Some producers have recommended the addition of small amounts of tin, claiming attendant benefits, while others discredit the value of the tin. The same holds true with respect to aluminum. It is generally conceded that lead is essential in order to produce desirable machining qualities, but producers are at variance with respect to the amount added to give the maximum benefits.

The purpose of one paper was to study the effects of varying additions of these elements upon the properties of die cast brasses, confining the investigation to the effect upon Muntz metal or yellow brass mixtures. The investigators along this line were C. B. Malin and W. W. Sieg, of Pennsylvania State College and Titan Metal Mfg. Co. respectively.

A number of mixtures were made into test bars and physical tests were performed on them. All the data is shown in Table 7. A Joseph Polak, type 700, die-casting machine was used to produce the standard test bars as specified by the A.S.T.M. The casting temperature was held at 1650 deg. F. The Fe Si were added in the form of an intermediate Cu-Fe-Si alloy, as plant experience has shown that the elements in these proportions assist in producing a good slush for castings.

The conclusions drawn by the authors were: The addition of aluminum improves both the working and finish of the metal. Maximum ultimate strength occurs at ½ per cent Al, and porosity averages 45 per cent. When Fe and Si are added, Rockwell hardness and yield points are visibly increased. Reduction of area and elongation are decreased while the first addition of Al lowers the ultimate strength and then it rises to about the same figure as without any Fe and Si.

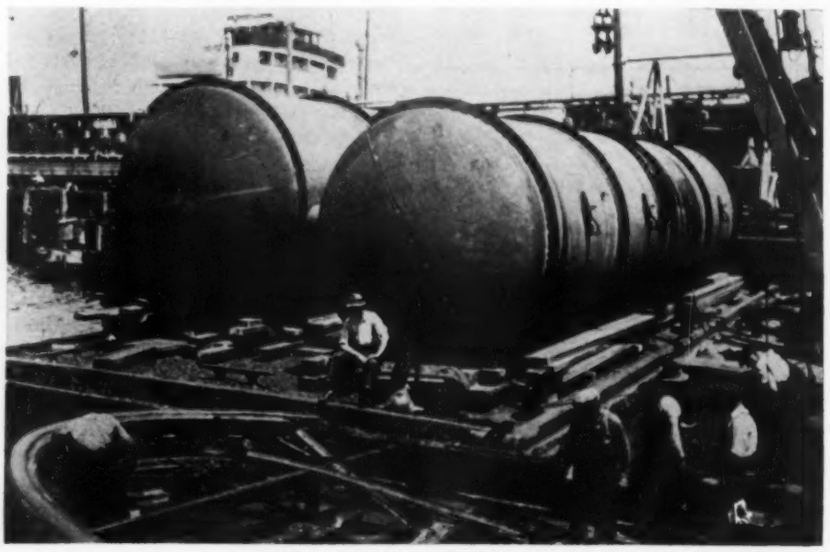
Speaking of the lead constituent, the authors noted that with higher lead the Rockwell number increases slightly, while the yield point stays virtually the same. Ultimate strength, reduction of area and elongation fall off markedly. With the further addition of Fe and Si, the yield point, strength and hardness increase while the ductility falls off, as is to be expected. It appears that Pb should be kept as low as possible, say around 0.25 to 0.50 per cent, as these alloys have been found to have good machinability, while the other physical properties are superior to those containing greater amounts of Pb. Porosity is apparently at a minimum in these alloys.

An addition of Sn up to 0.5 per cent in Muntz metal increases the yield point, tensile strength and hardness while the ductility shows a decrease. Further addition of Fe and Sn increases the tensile strength but does not materially change the yield point, hardness or ductility. Lack of porosity was better than in the compositions containing Al but poorer than in those containing Pb.

The authors believe that this information will aid users in the forming of saner specifications for die castings. Consumers can use this data and thereby have information so as to exercise a choice between a die casting or forging and thus avoid some of the "black eyes" the die-casting industry has received through the failure of users to recognize the limitations of die castings. The authors intend to continue the above study with more compositions in the yellow brass field as well as a study of the red brasses and nickel silvers.

## Welded Pontoons for Seaplane Ramp

THE arc-welded tanks shown in the accompanying illustration are a part of New York City's new commuter seaplane ramp, located on the East River at the foot of Wall Street. Two of them measure 46 ft. long and 12 ft. in inside diameter, and have ⅜-in. steel walls and 7/16-in. steel heads. The other two are of the same length, but are 11 ft. inside diameter and have 5/16-in. steel walls and ⅜-in. steel heads. Steel plates arc-welded inside on 11.3 ft. centers divide each tank into four watertight compartments. Each tank weighs approximately 12 tons. About 95,000 lb. was fabricated, requiring about 6000 ft. of welding. The tanks were welded both inside and outside, ¼-in. bare wire and Hobart arc-welders being employed. The welding was done at the Arlington works, Staten Island (New York), of the Buffalo Tank Corpn.



The ramp was built in the Brooklyn Navy Yard. It weighs 165 tons and covers an area of 45 by 85 ft., accommodating a turntable, a fueling station, a waiting room for passengers and other features. From it will be operated a daily commuter air service to Long Island points.

TRENDS in passenger car design will be reviewed by Henry M. Crane, technical assistant to the president of the General Motors Corpn., at the opening meeting of the Metropolitan Section of the Society of Automotive Engineers, which was held on Monday evening, Oct. 8, at the Roger Smith, 40 East Forty-first Street, New York. As heretofore, the meeting was preceded by an informal dinner.

# Convention Reflects Wider Use of Welding

## *Includes Data on A. C. Arc Process, Car Fabrication And Track Welding, Sprayed Metal Coatings and Brazing with Silver Solders*

WITH more than 30 papers at the seven technical sessions and a registration in excess of 525, the 14th fall meeting of the American Welding Society, held at the Hotel New Yorker, New York, Oct. 1-5, was one of the largest in the history of the society.

A session devoted for the most part to alternating current arc welding attracted a large attendance. A railroad session registered progress in track welding and steel car fabrication, and discussions of sprayed metal coatings, hard facing, and silver solder brazing were well received. A symposium on the qualifying of operators of welding equipment featured a large number of speakers. Fundamental research continues to be an outstanding activity of the society; one session of the meeting included five reports of as many investigations, while another, arranged by the society's structural steel welding committee, included the initial report of an investigation of welded seat angle connections.

Plant inspection trips, committee meetings and the annual banquet were other activities. Welding and cutting equipment of all varieties, electrodes and supplies, as well as displays of welded products and of steels for all types of fabrication, were to be seen throughout the week at the National Metal Exposition, which was held at the Port of Authority Building, New York.

The Samuel Wylie Miller memorial medal for 1933 was awarded to J. C. Lincoln, chairman of the board, Lincoln Electric Co., Cleveland, for his contributions to the advancement of electric fusion welding.

Safeguarding of the rapid advances being made in fusion welding, by maintaining high standards of welding quality, was urged by Dr. D. S. Jacobus, advisory engineer, Babcock & Wilcox Co., New York, and president of the society, in opening the convention. Rapid growth in the use of fusion welding and the increasing field of possibilities were emphasized. Five years ago there were no fusion-welded steam boilers for high pressures, whereas today practically all new high-pressure and high-duty boilers have fusion-welded drums, he said.

## *Pressure Vessels Welded by A. C. Arc Process*

APPLICATION of automatic alternating current welding in the manufacture of Class I pressure vessels at the plant of the Foster-Wheeler Corpn., Carteret, N. J., was described by C. A. Tilton, industrial engineering department, General Electric Co., Schenectady, at a session devoted for the most part to A. C. arc welding.

Development of suitable electrodes was said to be largely responsible for making practical the use of A. C. in the heavy current field of pressure vessel welding. There appears to be but one advantage to be gained by using A. C. for welding, the practical elimination of magnetic blow, but that is a very important one from the standpoint of increased speed, more uniformly high quality results and reduced unit costs, said Mr. Tilton.

Disadvantages of A. C. were also pointed out. Experience was said to have shown, however, that elimination of magnetic blow is, in many cases, of so great importance as to outweigh these disadvantages, which include:

A. C. welding is now only practicable with single phase, and inherently involves either low power factor or low efficiency. The two former, generally considered undesirable load characteristics by power companies, sometimes involve excessive penalties unless power factor and phase distribution corrective equipment is also installed.

The first cost of A. C. equipment is no lower, and may be higher, than D. C. when corrective equipment is required.

A psychological element is involved in the use of A. C., which is probably inherited from the earlier days when A. C. equipment was less reasonably designed. This is a fear of shock on the part of the welding operators. We call this psychological because it is actually unjustifiable, since present application of

DR. D. S. JACOBUS, advisory engineer, Babcock & Wilcox Co., New York, and president of the American Welding Society.

J. C. LINCOLN, chairman of the board, Lincoln Electric Co., Cleveland, and recipient of Samuel Wylie Miller Medal for 1933.

A. C. tends toward use of such low values of secondary voltage as to make the danger practically nonexistent. Voltage-reducing auxiliary attachments eliminate this objection, but, of course, add certain costs which are a necessary evil—we hope of a temporary nature only.

Equipment for A. C. welding, including transformer units and an automatic welding head, was described briefly, as well as fixtures for holding the work in position and for traversing the arc across the work and vice versa. These vary with the plant layout; all are based, however, on the principles of rolling devices for circumferential seams and travel carriages for longitudinal seams.

At the Foster-Wheeler plant A. C. automatic arc welding is used exclusively for all seams excepting tank fittings, which are applied by hand welding with A. C. This installation has been in operation since May, 1934, and production up to Sept. 1 has been about 225 tons of Class I vessels.

The experience of the Foster-Wheeler Corpn. was said to be that A. C. automatic welding gives somewhat greater net welding speeds than obtained with D. C. and fewer defects to be chipped out. On hand welding, excepting with low current values, the operators like the A. C. arc to handle.

### A.C. Welding Transformer Characteristics

In a paper on "Alternating Current Arc-Welding Transformer and Circuit Characteristics," A. M. Candy, welding engineer, Westinghouse Electric & Mfg. Co., discussed various transformer and circuit characteristics to show what effects they have on the welding arc from an arc-striking and maintenance standpoint, and also the effects upon the volume of current delivered through the arc and on general operation.

Alternating current for arc welding has been used in England and Europe for many years; also in the United States for many years, but much less extensively. Reasons for this apparent discrepancy were said to be, first, that there were no satisfactorily covered electrodes available in the United States at a price to compete with bare electrodes. Second, arc welding transformers had not been developed which would make bare electrode welding comparable with direct-current power. Third, the general advantages of heavily-coated electrodes with alternating current for producing high-class welds had not been developed. However, this general situation is gradually changing, said Mr. Candy.

Both reactance-controlled and resistance-controlled transformers were described, and also the application of equipment to protect the operator.

In a brief address on "Acceptance of A. C. Welding," C. J. Holslag, engineer, Electric Arc Cutting & Welding Co., Newark, N. J., who developed an A. C. welder in 1918 or before, stated that in this country, at least, practically all companies complying with boiler code requirements for Class I vessels use alternating current for the reason that it makes a better weld deposit, with finer grain structure and less slag and gas inclusions.

Mr. Holslag offered the following explanation of the difference in action between A. C. and D. C. in arc welding: "Arc welding is a combination of metallurgical and electrical engineering, and I believe from observation that alternating current so agitates the molten puddle that during solidification the crystal growth is aided. The aid comes in two ways. First by mechanical agitation through the alternating current magnetic influence, and second, but not secondarily, the reversal action of 50 or 60-cycle current keeps the puddle molten so as to allow more time for the desired grain structure to grow." This extra time accounts, he said, for the less gas and dross inclusion.

Alternating current lends itself admirably to automatic arc welding conditions, Mr. Holslag said. The apparatus is simple. "A drive motor with two circuits and a fixed field will feed downward on the arc voltage balanced against a fixed reactance voltage and upward on short-circuit or overbalance of the fixed or reactance voltage. There are no relays, switches or timed action. The control is inherent. The response is immediate and not subject to sequence," he said.

### Welded Tanks for Sub-Zero Use

A comprehensive paper on "Impact Resistance of Some Steels and Welds at Sub-Zero Temperatures," by R. K. Hopkins, director of metallurgical research and development, M. W. Kellogg Co., was presented at this session. This study was made in connection with the design of a de-waxing plant which required very large vessels and extensive piping systems and was to be absolutely safe to operate at —40 deg. F. Six commercial steels, carbon-molybdenum, carbon-silicon, plain low carbon, 2¼ per cent nickel and carbon vanadium, were selected for test. All welds were made between two plates 9 x 18 in., with the weld extending along the 18-in. edge. Impact resistance tests were made later on three grades of manganese steel plate, but no welding tests were made.

Upon completion of the tests, a full-size tank 48 in. inside diameter, 8 ft. long and 1¼ in. thick was made of the 2¼-in. nickel steel, which was regarded as the material showing the most promise. The tank included two 8-in. nozzles and one 20-in. manway. Fabrication was under regular shop conditions. After completion the tank was stress relieved, and all longitudinal and girth welds X-rayed. Physical tests included normal tensile and bend tests at room temperature and at —50 deg. F., the tests being run on weld metal, shell plate, headplate and manway weld and neck.

From this study it was concluded that welding on a production basis of 2¼ per cent nickel steel tanks having good impact values at sub-zero temperatures is entirely feasible. Also that high nickel content in weld metal is not necessary to obtain good low-temperature impact resistance, and that it is essential to guard against materials containing dendritic structures. It was found that acceptable field welds can be made on 2¼ per cent nickel steel pipe, and that local stress relief of welds on pipe of this steel has no detrimental effect on the pipe.

## Main Line Track Welded Into Long Lengths

ADVANTAGES of welded track are so many and so far-reaching that they cannot be overlooked when, at this time, economies in maintenance are so necessary, and improved track conditions so essential, said H. S. Clarke, engineer, maintenance-of-way, Delaware & Hudson Railroad, in a paper on "Welded Rail Joints in Main Track of Steam Railroads," presented at the railroad session of the A. W. S. meeting.

Advantages of indefinitely long rail lengths—lengths only to be governed by necessary breaks for signal circuits and switches—were summarized as follows: Savings in maintenance costs and maintaining joints; longer life of rails, due to elimination of joint batter; labor saving in laying rails, due to increased life; better conductivity in track circuits, and elimination of necessity for bonding joints. Also saving in maintenance of rolling stock and motive power; and smoother riding track, with the continual pound from joints eliminated.

In Europe, the electric arc, thermit pressure and electric flash methods have been used to weld rails together. Arc welds were said to have a relatively short life under these conditions, although with present knowledge of electrodes and fluxes an arc welded joint could be produced which, with proper heat treatment, would be satisfactory.

Thermit welding has been used successfully in Europe for a number of years. From a straight collar weld came the improved thermit pressure weld, using the thermit collar around the base and web, and a heat pressure weld on the head or ball of the rail. The electric flash weld method is a development of the simple butt welding process, and in Europe the ma-

chines are semi-portable. They can be erected at convenient depots, taking rail to the machine to be welded in 90-ft. or longer lengths.

### Welded Stretches Give No Trouble

In cooperation with the Metal & Thermit Corpn. an experimental stretch of rail was welded in track during the hot weather of Aug., 1933, on the Delaware & Hudson Railroad. Rail laid varied from 500 to 2800 ft. lengths, a total of 300 welds being made. At the ends of the welded stretches the rails were connected with regular track joints and in one case an expansion joint was installed. No trouble was experienced with this track, the ends or joint-connected rails showing no greater tendency to expand or contract than the 39-ft. rails in the other track.

Five of the 300 joints welded failed, two because of defective welds. The other three failures occurred during extremely cold periods. All failures were in the southbound track and none in the longest stretch of welded track. The three failures occurring in the cold weather have been identified as welds which were left for expansion during the progress of the work and later welded up, resulting in poor welds with excessive strains, due to the clamps used being unable to move the rail and provide sufficient pressure. On the northbound track all rails were welded consecutively and no failures occurred. This track has been in service for a year and no trouble has been experienced from contraction or expansion.

In May of this year 250 additional joints were welded at Mechanicsville, making four rails each approximately 2000 ft. long.

"I am often asked," said Mr. Clarke, "what we will do about rail heats developing excessive transverse fissures, necessitating the removal of the entire heat. Until lately no great attention was paid to keeping heat numbers together. However, it is practical for the steel companies to ship at least 90 per cent of each heat together, so that the rails can be laid in one stretch; it then becomes a simple matter to take out an entire heat, if necessary, whether it is welded into one rail or not."

Use of welding in track maintenance was outlined at the same session in a paper by I. H. Schram, engineer, maintenance of way, Erie Railroad.

### New Light-Weight Car Fabricated by Shot Welding

The latest step in the modernization of city transportation, a new light-weight five-section car for the elevated lines of the Brooklyn-Manhattan Transit Corpn., was described by M. B. Butler, Jr., welding engineer, Edward G. Budd Mfg. Co., Philadelphia, in a paper on "Technical Phases of Application of Welding in the Hi-Tensile Division of the E. G. Budd Mfg. Co." In Mr. Butler's absence the paper was presented by W. Spraragen, technical secretary of the A. W. S.

The new car reduces car weight to 250 lb. per passenger and increases operating speed to a point where local service equal to former express service is provided. An actual increase in the factor of safety as well as a substantial lessening of weight is accomplished.

In designing the car particular attention was paid to passenger comfort. All trucks are mounted in noise and shock deadening rubber. The floor is of inlaid cork, which not only insulates against sound and cold, but is easy to stand and walk on. Through articulation, adjacent ends of each two sections rest on a common truck, thus eliminating four trucks. The five sections therefore can properly be called an articulated car rather than a train. An outstanding advantage of this type of construction is the fact that various sections perform as a single unit instead of as so many individual cars whose ends fight each other in starting, stopping and rounding curves. Substantial reduction in operating costs is expected also.

The car is framed entirely with 18-8 stainless steel. The steel is cold rolled into bright strips 0.01 and 0.05 in. thick and these strips are drawn and built up to form the required shapes and members. The Budd "shot-welding" method was employed throughout in forming each of five bodies into a single and practically one-piece assembly which is strong enough to resist shocks far in excess of those usually encountered. Description of the technical features of the shot-welding method, which has greatly extended the fields of use of stainless steel, also formed an interesting part of Mr. Butler's paper.

## Gives Data on Silver Solders and Their Use

STRENGTH, ductility, corrosion resistance, electrical conductivity and other properties of silver solders, methods of using such solders and the action of various fluxes were outlined by Robert H. Leach, manager, Handy & Harmon, New York, in a comprehensive paper on "Brazing With Silver Solders."

It was stated that although it is possible to produce silver alloys which melt at temperatures below 1000 deg. F., the term "silver solder" is usually applied to brazing alloys which require a red heat to melt them.

Silver solders can be used on practically all ferrous and nonferrous metals and alloys having melting points above 1300 deg. F. They can be obtained in forms required for different sizes and types of joints—in granular or filed form, in sheets and strips from a few thousandths to any heavier gage and in wire in all diameters.

Their free-flowing properties and relatively low temperatures permit designing of joints with small clearances which will have great strength and ductility and will stand severe shocks and bending stresses. A wide factor of safety is provided against damage to metals and alloys through overheating the parts to be joined, because of the low temperatures required to flow silver solders. The time required to make the joint is correspondingly shorter and the labor cost is proportionately reduced, it was stated.

Malleable butt and seam joints can be made which will stand severe cold work, such as hammering, rolling, drawing and forming into different shapes. Scarf and lap joints on sheet metal and properly fitted pipe joints were said to show high strength, often exceeding that of the metals themselves.

It was pointed out that although the cost of silver solders per unit of weight is greater than that of base metal alloys, when all factors are taken into consideration the cost of making joints with silver solders is not necessarily proportionately higher. The strongest joints are obtained when a minimum amount of solder is used; by proper design of joint the actual weight of silver solder is so much less than that required for equivalent strength with base metal alloys that in some cases even the difference in first cost is negligible, said Mr. Leach. In addition, the lower temperature required, the saving in time and fewer rejections will, in many cases, offset the higher initial cost of the solder.

A wide range of equipment—torches, furnaces and electrical devices—is available for supplying the heat for joining metals with silver solders. Air and gas torches are used extensively, but the oxyacetylene torch was said to give a much wider range of flexibility and quicker heating. The necessity for preheating the surfaces to be joined is greatly reduced and there is a saving in time as well as the advantage of being able to control the type of flame. In discussing furnaces for heating, Mr. Leach pointed out that the atmosphere used for brazing should be nonoxidizing. Proper control of heat was emphasized as an important factor in obtaining uniform and strong joints.

As to the advantages of using silver solders with stainless steels, it was said that there is a diversity of opinion. Strong joints can be made

with a wide range of compositions, but the temperatures required for the use of silver solders comes within what has been generally accepted as the critical range which causes carbide precipitation, and that is probably one reason why silver solders have not been more widely used, said Mr. Leach. It is possible to produce a malleable and ductile silver solder containing sufficient zinc and cadmium to bring their flow points below 1200 deg. F. If we consider, he said, that carbide precipitation is a time and temperature reaction it would seem as if the use of a silver solder with such a low flow point might overcome most of this difficulty if the heating is done quickly.

### *Sprayed Metal Coatings Have Wide Application*

PROPERTIES and applications of sprayed molten metal coatings, applied by the Metalayer process, were described by E. V. David, applied engineering department, Air Reduction Sales Co., New York, at the same session.

In this process a self-contained portable spray gun melts, atomizes and sprays any commercial metal to form coatings on surfaces of any size and shape and of practically any material. The coating may be built up to any desired thickness. The metal to be sprayed is supplied in the form of wire.

With the standard spray nozzle held perpendicular to the surface being coated and 5 in. distant from it, the molten metal spray covers a circle about 2 in. in diameter. A single pass over the surface sprays a coating from 0.001 to 0.002 in. thick, depending on the metal being sprayed.

Metals of any melting temperature up to that of tantalum, namely 5250 deg. F., can be sprayed. Wire feed speeds range from about 10 ft. per min. for high melting point wire to 34 ft. per min. for low melting point wire. Weight of wire used ranges from about 1¼ lb. an hour for iron to about 40 lb. an hour for lead. Weight of metal coatings sprayed ranges from about 1.2 lb. an hour for iron to about 18 lb. per hour for lead. Area of metal coated to 0.006 in. in thickness ranges from about 6 sq. ft. an hour for iron to about 60 sq. ft. an hour for lead.

The gun operates with oxygen and acetylene pressures ranging from 13 to 15 lb. per sq. in. and in compressed air pressure from 45 to 55 lb. per sq. in. About 23 to 26 cu. ft. of oxygen, 22 to 25 cu. ft. of acetylene and 2500 to 3500 cu. ft. of compressed air are consumed per hour per gun.

#### Inaccessible Surfaces Coated

Special spray nozzles of rotary, fan and angle types have been developed to permit metal coating of inaccessible surfaces, such as the inner wall of pipe and tubing and small cylindrical objects. These may be attached directly to the gun or used with extensions ranging from 30 in. to 12 ft. in length.

Photomicrographs of sprayed molten metal coatings show that they are made up of a multiplicity of plastic particles which, by high velocity impact on a surface, are flattened out and interlocked, first with the microscopic open grain of the surface on which they are deposited and subsequently with each other. For maximum adhesion the surface of the base metal must be properly roughened. On properly prepared surfaces correctly applied sprayed metal coatings were said to become practically integral with the surface and to show many properties of metals cast in the usual manner. No claim is made that sprayed molten metal coatings are either welded or brazed to the base metal. The firm adhesion obtained is due solely to the mechanical bond.

Sprayed molten metal coatings may be polished, ground, turned, filed or otherwise finished just as cast metal may be. Polishing or grinding, however, requires care to avoid cutting through to the base or overheating the surface.

Considerable research has been devoted to determine the most suitable and least expensive means of securing a properly roughened base metal surface. The best method, it was stated, was found to be sand or grit blasting, which has the additional advantage of producing a chemically clean surface on which to spray the molten metal.

#### Spray Gun Used in Lathe

Applications pictured included heat-resistant as well as corrosion resistant metal coatings, the former by a combined metal coating and heat treating process known as "alumetizing."

Use of the metal spray gun in a lathe toolpost for turning parts "up," as in enlarging cylindrical pieces held between centers, was also illustrated. Repairing of surface defects that show up after machining of castings and forgings, and a number of applications in the decorative field, including patterns produced by means of stencils, were shown. Electrical equipment manufacturers use metal coatings on both conducting and insulating materials. Lead sprayed on glass furnishes an inexpensive condenser plate; other applications include sprayed zinc on radio tubes and coatings for electric, magnetic and thermic shielding effects.

Small pieces, up to 1 lb., may be mass coated in bulk. Such parts are placed in a special rumbling barrel in lots of about 100 lb. and sprayed molten metal is directed on the pieces as the rumbling barrel is rotated mechanically.

#### Hard Facing Prolongs Life of Machine Parts

Developments in hard facing—the process of welding on to wearing parts a coating, edge or point of a metal highly capable of resisting abrasive—were covered in a paper by B. E. Field, chief metallurgical engineer, Haynes Stellite Co. Hard facing increases the life of the parts, hard-faced surfaces outwearing steel from 2 to 25 times. In reducing replacements it saves in labor charges and lost production time. Hard facing also permits utilization of cheaper base metal for wearing parts.

Uses of hard facing in a wide variety of industries were shown by lantern slides. In the automotive field exhaust valve seats of truck and bus engines are being hard faced, such seats requiring less attention and reducing valve grinding and adjustments to a minimum. Tests are said to have shown that after runs of 100,000 miles or more no regrinding or refinishing of the valves was necessary. Dies, cams, burnishing broaches and other production tools and machine elements are hard faced in addition to a variety of engine and other automobile parts.

Extensive use is made of the process in the cement, excavating, mining, brick and other industries. Electric mud guns, tap hole augers, skulling hooks, charging rams, gag press hammers and shear blades are among many applications in the iron and steel industry. In agricultural machinery extensive use is made of the process for plow shares. Hard facing procedure, including the use of special work-holding fixtures, was also described.

#### Welding Research Active

REPORTS of seven or more fundamental research undertakings of the A.W.S. were submitted, five of them at a session under the auspices of the American Bureau of Welding, the research division of the society. These were: "Effect of Peening on Physical Properties of Welds and Stress Relief," by O. M. Harrelson, Georgia School of Technology; "Residual Welding Stresses," by R. E. Jamieson, McGill University; "Note on the Fatigue Testing of Welds," by J. H. Zimmerman, Massachusetts Institute of Technology; "Corrosion Fatigue of Welded 18-8 Stainless Steels," by W. E. Harvey, A. J. Ciastkewicz and F. J. Whitney, Lehigh University, and "Resistance Welding of Duralumin," by N. F. Ward, University of California.

The first reports of an investigation of welded seat angle connections were presented in two papers at the session under the auspices of the A.W.S.

*(Concluded on page 76)*

# Proposed Capital-Labor Truce Should Welcome Sound Philosophy of Employee Representation Plans

A TRUCE between management and labor is now the Utopian hope of the Administration. Will this hope prove to be a mirage, or will it be fulfilled? A glance at the lingering war-clouds on the labor-capital horizon forestalls a definite answer.

The veritable warfare that has swept the nation ever since the birth of the famous Section 7-a is dismissed by the quotationalists with the axiom that "at the birth of every economic upheaval, violence is the midwife." But those who have placed their entire stake on national progress cannot condone with contrite phrases the present social unrest. They are seeking the cause for the crossing of swords. And there is no scarcity of willing ears to any sound proposal for peace.

An even casual review of events during the past 15 months will provide a clear idea of the reason for the general uprising. Broadly, the New Dealers through their academic theorizing have succeeded in breeding a paternalism toward labor that has no equal in the nation's history. Whether motivated by political acumen or by sincere effort for the common good, the program has been damaging to civic and industrial peace.

Therefore, before the way to a truce can be paved, the road first must be cleared of the many snags growing out of controversial emergency legislation.

By GEORGE EHRNSTROM, JR.
Resident Editor at Pittsburgh, THE IRON AGE

The steel industry, although thus far having escaped violent labor outbreaks, is nonetheless jittery with uncertainty. This nervousness is indeed easy to diagnose. Steel labor, through secret ballot, has expressed itself overwhelmingly in favor of employee representation plans for exercising collective bargaining rights under recovery measures. The results of many employee elections, published previously in THE IRON AGE, are undeniable facts.

**IN the opinion of the author, who has had an excellent opportunity for first hand observation of the steel labor situation in the heart of the industry, the much desired "truce" between capital and labor can be achieved only if the Administration at Washington clarifies certain points at issue.**

**It must recognize the need of checking incessant disturbance of industrial peace by professional unions, bearing in mind that their membership includes only a small percentage of the industrial workers of the country.**

**It must take heed of economic influences and not attempt to "freeze" wages and working hours in the face of sharply fluctuating demand unless a Government subsidy for sustained industrial engagement is being considered.**

**It should encourage definite determination of the constitutional powers of various Governmental labor bodies and provide a final, unequivocal interpretation of the intent of Section 7-a.**

A recrudescence of agitation on the part of professional unions, however, belies the general willingness of labor unions to accept the expressed desire of steel workers to deal directly with managements. The latest airings of union-sponsored grievances have not tended to calm steel managements' nerves, for it is clearly indicated that the attitude of organized labor leaders presumes Government sympathy in union attempts to dominate steel workers. In all cases of alleged grievances, steel union members have expressed a desire to have Federal-supervised elections for establishing collective bargaining agents.

The latest parade of union complaints against steel managements was held recently at Pittsburgh and embraced three of the most important steel producers in the country: Carnegie Steel Co., Republic Steel Corpn. and Jones & Laughlin Steel Corpn. The drum major was the Amalgamated Association of Iron, Steel and Tin Workers, an affiliate of the American Federation of Labor.

In the Carnegie Steel Co. hearing, the union contended that the company's present employee representa-

tion plan nullifies the rights of union workers to self-organization. The union sought further to induce the National Steel Labor Relations Board, before which the complaints were reviewed, to order further elections at the Carnegie company's Duquesne works and McDonald mills. The company was charged by the union with trickery, intimidation and other forms of duress in connection with the company's employee balloting on the question of representation.

The union contended further that the McDonald plant is a separate unit and could not logically be included in the company's Youngstown district operations. On the last mentioned premise, the union maintained that the vote at the McDonald plant, which rejected the company representation plan by a count of 714 to 627, should be considered apart from the results of the vote for the entire Youngstown district, which was favorable to the employee representation plan by a conclusive majority. The Carnegie company endeavored to prove that the McDonald plant is an integral part of its unit operations in the Youngstown district.

### Union Philosophy Antagonistic

The keynote of the steel industry's attitude was struck by Arthur H. Young, vice-president in charge of public relations, United States Steel Corpn. The basic philosophy of national unions, he stated at the hearings, is that the interests of management and labor are antagonistic, whereas the employee representation plan of the Carnegie Steel Co. is based on cooperation for mutual advantage. The plan is fundamentally adaptable to all plants, with only minor variations to conform with special conditions existing in various producing districts.

A practically open acknowledgment of Mr. Young's contention respecting union antagonism was made by Charlton Ogburn, counsel for the Amalgamated. Said Mr. Ogburn: "From the point of view of union labor, individual bargaining against such a combination of employers (Carnegie Steel Co.) is futile. The company has left out the word 'organize' in its plan. We must have an organization of workers on one side of the table to bargain with these organizations of employers on the other side to meet the provisions of the NRA. The power an organization of workers needs is the *power to strike*. I know of no other power that the workers can have."

Administration plans for a truce cannot very well ignore the foregoing two representative declarations.

A particularly significant point in the hearings against the Carnegie company was the company's stipulation that it appear before the National Steel Labor Relations Board informally and without recognizing the board as a jurisdictional body. Although somewhat irked by the demand, the board agreed to hold the discussions on an informal basis.

### Discrimination Charged to Republic

Alleged discrimination against employees of the Republic Steel Corpn. at its Warren and Niles, Ohio, plants was the next case before the board at Pittsburgh last week. Five members of the Amalgamated Association testified that they had been discharged by the company for union activities. The Republic company discredited the union's charge of discrimination, claiming that the men had been laid off solely because of economic conditions. The union complaints were submitted for the board's later consideration.

Fear of physical violence at Aliquippa, Pa., site of one of the Jones & Laughlin Steel Corpn. plants, was the next charge served before the labor board, this time by the Amalgamated's vice-president, E. W. Miller. In line with his plea, the board set Oct. 15 for hearing further charges of coercion and intimidation on the part of the company.

Meanwhile, the board has retired to Washington and is expected to announce its findings in the Carnegie and Republic hearings within 10 days.

### Steel Labor Board's Jurisdiction Challenged

Stripping the proceedings at Pittsburgh of their legal maneuvers and prolonged discussions of minor technicalities, the issues narrow down to one point: Is the National Steel Labor Relations Board "merely a ghost flying about," to use the words of its chairman, Judge Walter P. Stacy, or can it function officially under the Constitution? Only a court test could probably settle the question. It is difficult to place any interpretation on the union's part in the Pittsburgh proceedings other than that it is using the labor tribunal as a "sounding board" in the union's opportunistic move for power.

### Weirton Hearing More Important Test

Another hidden snag in the road to a capital-labor truce is the court battle at Wilmington, Del., in which the Government is seeking a permanent injunction to restrain the Weirton Steel Co., subsidiary of National Steel Corpn., from alleged violations of collective bargaining provisions of the NRA. Again, the Amalgamed association is behind charges of coercion in connection with election of employee representatives. The importance of this case, which is not even in sight of a climax, is strongly stressed because it is being tried in a Federal court, which is expected to render a decision undoubtedly reflecting judicial opinion on the constitutionality of the National Industrial Recovery Act.

Predictions of the outcome of the Weirton case or of the findings of the National Steel Labor Relations Board on the hearings at Pittsburgh are precarious, at best. In the Weirton case, there is no established precedent upon which to shape a decision. If the steel labor relations board, after weighing testimony of witnesses in the Carnegie case, should order another vote on representation at the Duquesne plant and the McDonald mills, the company has intimated that it would resort to a court test before submitting to the board's discretion.

Such outcome of present labor cases foreshadows further strife. If the unions gain victory, their efforts to dominate steel labor will be doubled. On the other hand, the steel industry, as a whole, certainly would not waver in its historic position on "open shop." More food for Federal thoughts on peace.

### Public Opinion Opposes Strikes

While lengthy court battles and hearings are making their slow progress, public opinion on strikes is definitely fixed. The proposed truce between management and labor, as expressed by President Roosevelt in his last radio address, suggests his awareness of the public mood. But, in the meantime, what about the continued jabbings by professional unionists? In his truce plans, will the President heed the continued bickerings of opportunistic union leaders? Or will he recognize the honest efforts of industry to manage its own affairs? These questions remain unanswered for the time being.

### What About "Majority Rule"?

Clarification of the "majority rule," as it applies to collective bargaining, is a prerequisite to peace. Industry is again confused by diverse interpretations placed upon an all-important question. The old National Labor Board declared in the Denver Tramways case, when 52 per cent of the employees voted for the labor union and 48 per cent for the company union, that despite the small majority the union should be accepted by all employees as the bargaining agent. Further bewilderment on the subject was caused by the President, in connection with the settlement in the automobile labor controversy, when he sponsored proportional representation. Subsequent rulings of the old labor board on other cases were directly contradictory to the President's sponsorship of proportional representation.

A recent important "majority rule" case concerned the Houde Engineering Co., Buffalo, which announced its decision to refuse to abide by the declaration of the National Labor Relations Board for majority representation in employee collective bargaining. The National Association of Manufacturers subsequently urged industry unanimously to ignore the

board's ruling. This case is cited as another stumbling block to the hoped-for truce.

An encouraging note, however, was sounded by Donald R. Richberg in his address last week before the National Press Club at Washington, when he said that the Administration would protect the rights of individuals and minority groups in collective bargaining and that no effort would be made to force minorities to yield to the will of majorities registered in plant elections. This policy is an echo of the President's declaration for proportional representation in the automobile settlement. Richberg's pronouncement, though expressed unofficially, is believed to reflect a desire of the Administration to begin clarification of many muddled angles of Section 7-a. But whether Mr. Richberg's preliminary and unofficial clarification will meet with the approval of organized labor is another story. William Green, head of the American Federation of Labor, has already taken exception to Richberg's statement by declaring that the federation would use its entire resources to resist changes in the NRA policy on collective bargaining. Does this attitude augur well for industrial peace?

### What Do the Unions Offer?

While professional unions continue to shout their war-cries, what are they doing for the individual worker? A careful review of the past year fails to reveal any important progress for the worker gained through union leadership. The old union cry of higher wages and shorter hours has been hushed. And for good reasons. Labor has been emancipated to the full extent permitted by economic conditions. The steel industry, for example, has voluntarily recognized that the worker is entitled to a just share in its desserts. The scale of steel wages has twice been voluntarily advanced since July, 1933, while the working week has been established at a maximum average of 40 hr. Before NRA provisions on maximum working hours, managements had already recognized the fact that out of shorter working days is born greater man-efficiency. What, then, is the selling point of the professional unions? Simply the providing of the right to strike.

The National Industrial Recovery Act was an emergency measure to meet serious economic stress. Its intent is not questioned, but the results thus far are debatable. If the Government seeks an early industrial truce, it behooves the Administration to view all the facts of the labor situation logically, shut its vote-getting eye and evolve an expedient plan to undo some of the damage wrought by the famous "7-a."

### Great Britain's Example

First, the Administration might do well to restrict the activities of national unions. Great Britain's bankers set an example for American bankers, according to President Roosevelt. Why not benefit further from British example by studying the British Trade Disputes and Trade Unions Act of 1927? That act, while it does not propose to outlaw strikes or restrict legitimate activities of organized labor to further the interest of individual members, does restrict the unions in any attempts to coerce persons or groups not parties to a controversy. The act in part reads:

"It is hereby declared that any strike is illegal if it has any object other than or in addition to the furtherance of a trade dispute within the trade or industry in which the strikers are engaged; and is a strike designed or calculated to coerce the Government either directly or by inflicting hardship upon the community; and that any lock-out is illegal if it has any object other than or in addition to the furtherance of a trade dispute within the trade or industry in which the employers locking-out are engaged; and is a lock-out designed or calculated to coerce the Government either directly or by inflicting hardship upon the community; and it is further declared that it is illegal to commence, or continue, or to apply any sums in furtherance or support of, any such illegal strike or lock-out."

Next, the Administration might recognize the sincere efforts of industry to handle its own affairs. It has been conclusively established that employee representation plans are the accepted preference of a vast majority of wage earners.

The National Industrial Conference Board in November, 1933, conducted a nation-wide survey to determine the preferable method of employees in bargaining collectively with employers. Based on reports from 3314 companies with combined employment of approximately two and one-half million wage earners, the board found that 45.7 per cent of the employees covered in the survey were dealing individually with their employers, 45 per cent were dealing through works councils and 9.3 per cent through organized labor unions. As a check-up the conference board later conducted a further survey, to which responded 2975 of the companies that had reported in the first survey. These concerns in May, 1934, employed 2,636,847 wage earners. Employees of these 2975 companies in November, 1933, had dealt with their employers as follows: individually, 46.1 per cent; through employee representation, 44.9 per cent, and through labor unions, 9 per cent. In May, 1934, the proportions had changed, as follows: individually, 40 per cent; through employee representation, 49.6 per cent, and through labor unions, 10.4 per cent. In actual figures, the board found that 232,623 additional employees in the groups of plants had come under plans of employee representation and 58,397 more workers were dealing through labor unions.

Assuming that no drastic changes have occurred since May, it is clearly evident that organized labor, despite its presumption to speak for labor as a whole in dealings with the Government, is accepted by an exceedingly small minority as bargaining agent. It is difficult to understand, therefore, the forbearance that the Administration has shown in the broad demands and claims of national labor leaders.

The President, in his recent radio address, stressed the Administration's attitude toward self-government in industry. Doesn't self-government imply the right of managements to deal with employees without the interference of extraneous labor agencies? The National Industrial Conference Board's survey merits careful study by the Administrative powers seeking peace.

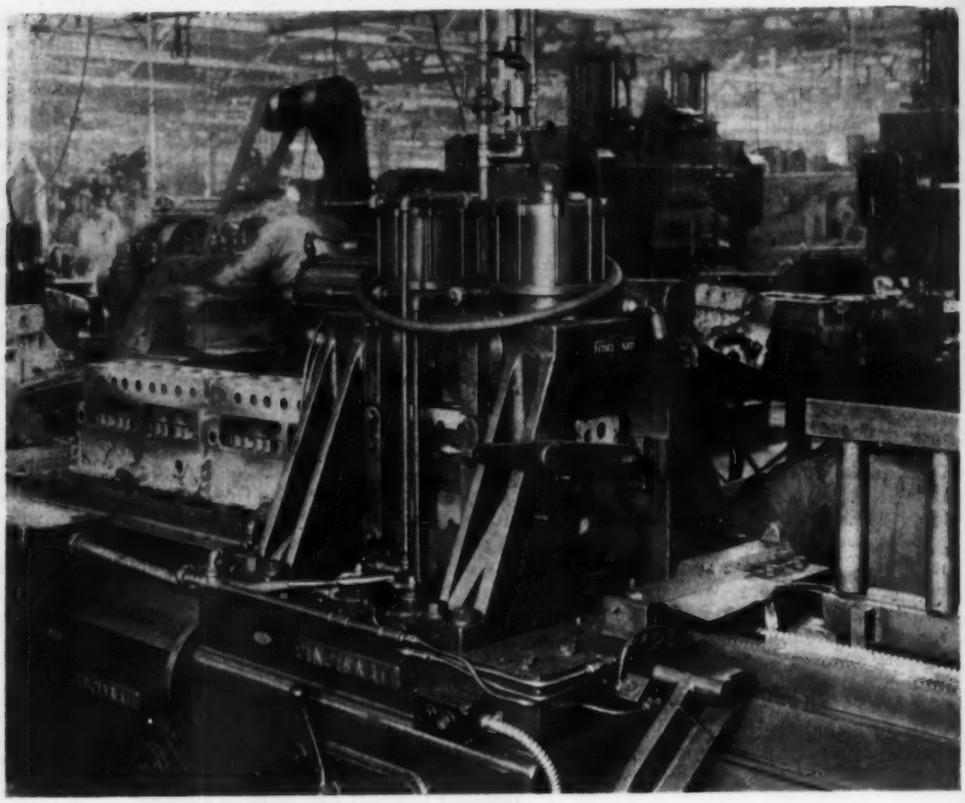
### Peace in Employee Representation

The steel industry's contribution to a peace proposal might well be represented in the Steel Corporation's employee representation plan. It is based on a sound philosophy and is sincere in its intent to place employer-employee dealings on a mutually beneficial basis. Moreover, while it might be termed an expediency, it is fundamentally applicable as a permanent vehicle that insures constitutional rights for the individual worker. Objection to this plan by the Amalgamated has been based largely on generalities, on hearsay and on vague testimony of union officials. Such objection is readily reconcilable when it is remembered that union leaders are loath to relinquish the golden opportunity, under "7-a," to resuscitate badly deflated treasuries. The steel union contends that the plan is not for the workers' best interests. As an alternative, the union offers the workers the right to strike; nothing else. The union's forte, in this case, suggests Administrative frowns in connection with any plans for industrial peace.

Thus union objection to a cooperative plan for mutually satisfactory relationship between employer and employee is ill advised. The union leaders also have apparently lost sight of public sentiment, though there is a noticeable tempering of militancy on the part of some leaders. The militant factions seem to be within the ranks of the unions. In the steel strike of 1919, Samuel Gompers, then head of the American Federation of Labor, had not been able to quell the bitterness among the local unions. The strike movement had gotten out of hand, and the strike was called without the support of the federation chief. Oftentimes, history repeats. It will be recalled at the hectic meetings of the Amalgamated lodges at Pittsburgh last spring, when the threat to call a steel strike was momentarily expected to be carried through, only the

*(Concluded on Page 76)*

# Plymouth Cylinder Blocks Broached At Rapid Rate



BEARING lock spots in cylinder blocks are broached at the Detroit plant of Plymouth Motor Corpn. on a Cincinnati Hydro-Broach machine made by the Cincinnati Milling Machine Co. This is the first broaching machine specially designed to perform this particular operation. The bearing lock slot in the Plymouth block is ⅛ in. deep, and the stock is removed at a rate of about 112 blocks an hour.

The machine consists of a bed-and-table unit, similar to a fixed-bed milling machine bed-table unit. The broach is mounted in a holder on top of the table unit, providing excellent backing for the broach. The table and broach are hydraulically driven, the hydraulic unit consisting of two pumps (of 50-gal. per min. capacity) connected in parallel. The total volume of oil flowing is 100 gal. per min. at about 1000 lb. per sq. in. pressure. The pumps are driven by a 30-hp. constant-speed motor.

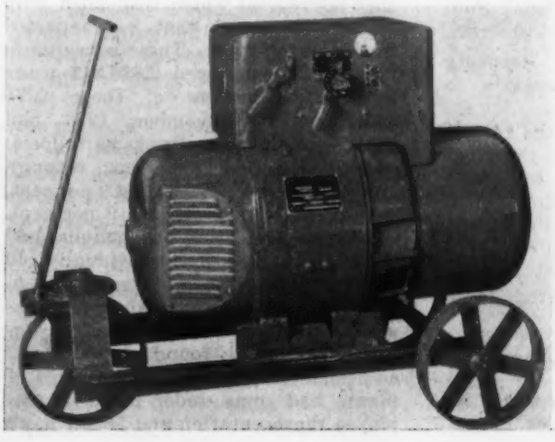
The full volume of oil is delivered to the cylinder on the broaching cycle of the table and to the rod end of the cylinder on the rapid return stroke of the table. The piston rod is approximately one-half the area of the cylinder, so that the rapid return stroke of the table automatically is twice the broaching stroke, thus saving time. A bridge-type fixture is mounted on the machine bed, bridging across the machine table and broach proper. Backing is provided behind each web in the cylinder block.

Fitting directly into the conveyor line, the machine is located so that cylinder blocks roll into position in the fixture on the machine. An air-operated elevator lowers the cylinder block into position for broaching, dropping it over the locating pins. The block then is clamped by air clamps, and the backing wedges, likewise operated by air, are engaged. At the end of the broaching cycle the broach stops and the block is unclamped, raised and rolled down the conveyor line while the broach is returning to starting position.

Adjustment both vertically and horizontally is provided in the finishing section of the broach so that a fine degree of accuracy can be secured for width and depth of the bearing lock slot. Tolerance for width and straightness of the slot is 0.0005 in. and for depth 0.002 in.

## Improved G-E Single-Operator Arc Welders

SELF-STABILIZATION resulting in excellent performance throughout the entire welding range, using any type of electrode, is emphasized by the General Electric Co., Schenectady, in introducing its new line of W-D 30 portable, single-operator arc welding sets. Characteristics of previous models have been retained, but refinements have been incorporated as shown in the illustration.



Having no external reactor, resistor, or separate exciter, these welders are self-contained. To the self-exciter design is attributed largely the self-stabilization feature, which is said to make the welding arc "peppy" and stable at all times.

Adjustment of welding current and voltage is by separate controls located on a dead-front panel on top of the machine. This panel also has a switch handle for reversing polarity and an instrument with selector switch for

*(Concluded on Page 77)*

# New Binder Ring Speeds Turret Lathe Operation

THE new H-2 turret lathe announced by the Warner & Swasey Co., Cleveland, and pictured on page 44, embodies a new type, automatic circumference binder ring which is said to be an important feature in that it permits the clamping and indexing of the hexagon turret by a rotation of the turnstile; an important consideration where the reduction of operating time is desired.

With 1-in. bar capacity and capable of 1480 r.p.m., this machine features a six speed, all geared head with ranges from 67 to 740 r.p.m., up to from 134 to 1480 r.p.m. A two-speed motor makes 12 speeds possible with range 67 to 1480. The head is fully equipped with anti-friction bearings, all gears are hardened alloy steel and have ground teeth. Sufficient power is supplied for heavy duty work with cemented tungsten carbide tools. The forward and reverse multiple disk clutch has ample area for high speed reversing. A 4 to 1 ratio high-low clutch makes possible wide range speed shifts without stopping the spindle. Head lubrication is by splash system. A double row of precision Timken bearings is used at the spindle front end and a precision loaded straight roller bearing in the rear.

The power feed is new. The initial reduction from the spindle is by V-belt. The entire train of gears is mounted in anti-friction bearings and all the apron gears are of hardened alloy steel. Lubrication is by grease, not easily washed away by coolant. The hardened worm runs in oil bath and is completely guarded. The six turret feeds range from 0.003 to 0.030; two change gears will reduce the feed by one-half.

### Choice of Cross-slide Hand Feed Method

Substitution of required parts permits arranging the cross slide for either or both lever feed or screw feed.

Special attention has been given to bar feeding elements; bars up to 5/8-in. are advanced with a friction finger lying immediately behind the collet inside of the spindle and are enclosed throughout their length, thus protecting the operator, reducing vibration and tending to prevent buckling. Bars above 5/8-in. diam. are fully enclosed at the rear end, being exposed only between the spindle end and the bar support tube; patents have been applied for on the new features incorporated in this bar feed.

# New Automatic Miller Handles Small Work

NEW in design, automatic in operations and convenient in the milling of small parts, in either large or medium quantities, are features, it is said, of cost reducing value which are incorporated in the new No. 1-12 plain automatic milling machine, shown on page 44, and built by the Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati.

The machine follows Cincinnati design in knee-type millers with a pyramid shaped column having self-alining rectangular dovetail overarm and light weight arbor supports.

### Table, with Automatic Working Cycle, Is at Convenient Height

The table has 8½-in. by 25¾-in. working surface at a convenient height. One T-slot, 11/16-in. wide, extends the entire length. Complete automatic working cycle, including 400-in. per min. power rapid traverse and dog control of intermittent feed and rapid traverse in any combination or direction, is specified. Control lever position determines the direction of table travel and also whether table movement is at feed or rapid traverse rate. Hand adjustment is by crank at the right of the knee, which is described as a husky unit incorporating long column and table bearings. Hand adjustment is provided for 8-in., vertical only. There is no saddle. There are 16 table feeds available, up to 80 in. per min., with pick-off gears; standard series ranges from 2-in. to 80-in. and special series from 1-in. to 40-in. per min. The spindle has a National standard No. 40 taper, 3½-in. taper per ft., 1¾-in. diam. at front end and 1-in. diam. at the rear end of the taper hole. The quill which carries the spindle can be moved at right angle to the table movement through the use of a quill clamping lever. A double mounting of anti-friction bearings, with self compensation, is provided in spindle assembly; helical gears lend to quietness of drive. Automatic spindle stop, for preventing the marring of work during the return stroke of the table, can be supplied and can be used with automatic table working cycles. Eight spindle speeds, up to 1800 r.p.m., by means of pick-off gears, are available. Three series of speeds: low from 49 to 361 r.p.m., intermediate upon request, and the high series 246 to 1800 r.p.m. Spindle reverse are provided. Stop and start of spindle is by convenient lever. There are three series of speeds.

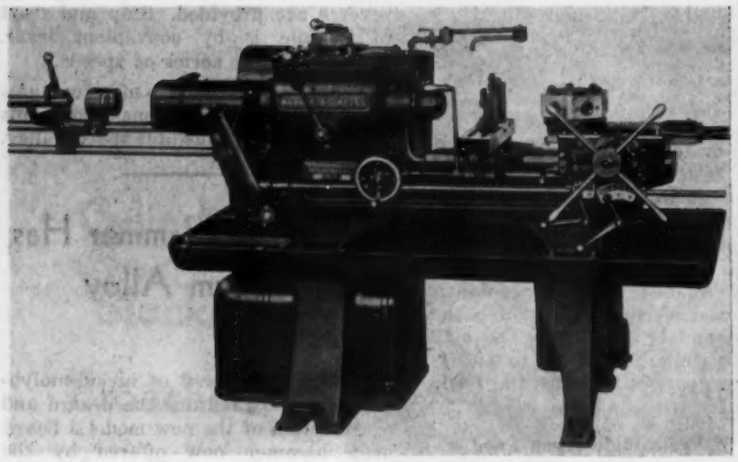
The 3-hp., 1800-r.p.m. constant-speed motor powers an enclosed double V-belt drive to a constant speed pulley.

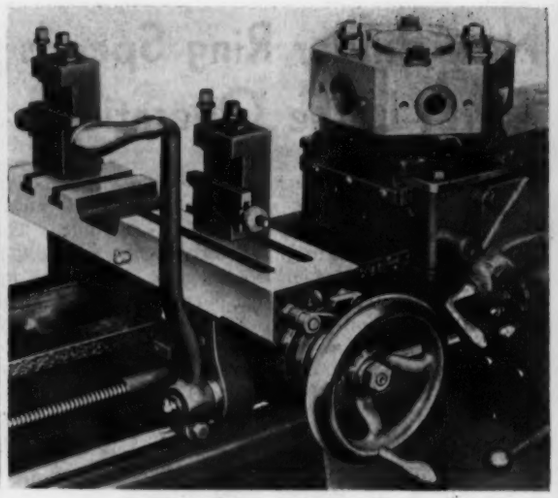
# New Drop Hammer Has Molybdenum Alloy Frame

FRAMES and anvil of nickel-molybdenum alloy feature the design and construction of the new model J board drop hammer now offered by the Chambersburg Engineering Co., Chambersburg, Pa. This alloy is produced in the redesigned air furnaces of the company and is said to have a tensile strength in excess of 50,000 lb. and to retain the damping properties of cast iron. The driving mechanism is classed as a spur-geared reducer with heavy pitch, wide faced gears and heavy duty Hyatt roller bearings. The motor is rigidly connected to the head and has flexible coupling drive. The motor driven head is in two sections which house the eccentrics, rolls and driving mechanism, with a cap to close the gear box. The anvil has a ratio of 20-to-1 to falling weight and incorporates the patented Chambersburg cross-guided joint. The frames are heavy, rigid, non-rocking members having integrally cast guides. The vees are longer and are widely spaced to offset any twisting tendency. The front rod is closer to the frame, has steel armored rubber bushing at the top and wide faced steel shoe plus heavy padding at the bottom. Universal and quicker action, through rod rather than by notched rack, is said to be gained in adjusting the releasing lever position. Pictured on page 45.

# Combination Goggles Provide Against Laxity

MANY types of work involve both dangerous light rays, as in welding, and eye hazard from flying particles. A combination goggle designed to protect the worker from these hazards, introduced by the Willson Products, Inc., Reading, Pa., is shown on page 45. This goggle designated as the DC50, may be used either with or without spectacles, which very largely eliminates danger from the often neglected precaution of changing goggles to suit the type of work at hand. This protective device was shown for the first time at the annual safety congress held at Cleveland during the week of Oct. 1.





NEW provisions incorporated in a No. 2 turret lathe announced by Warner & Swasey include protection for operator and assurance against the "whipping" of stock, featured in the (patent applied for) stock feeding mechanism. Details are given on page 43.

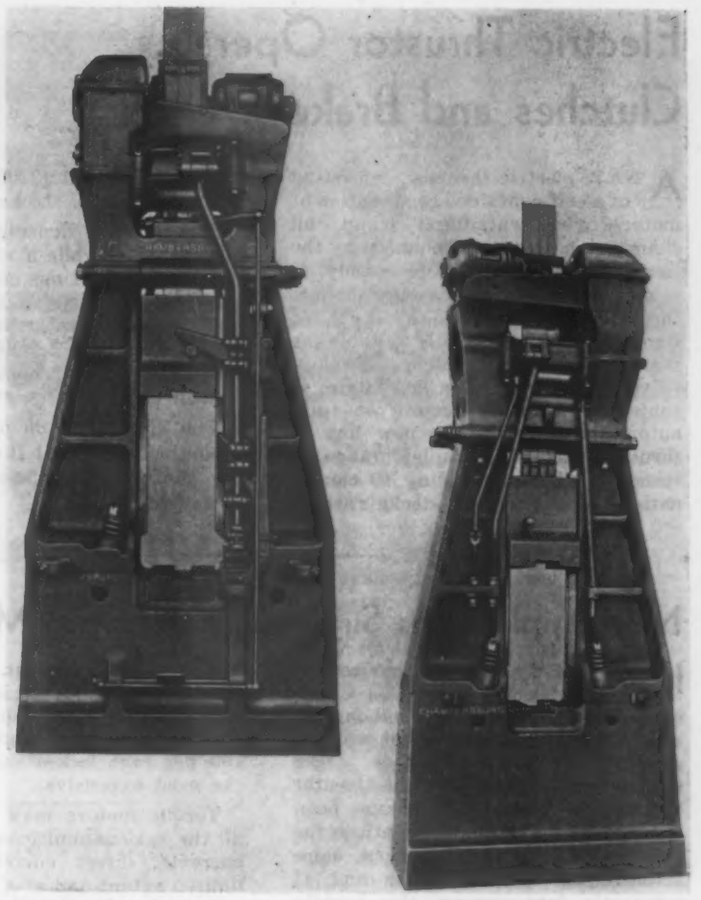
AT LEFT

BECAUSE of its heavy design this new Brown & Sharpe micrometer head is said to be particularly adapted to fixture use, either as an integral part of a fixture or by clamp attachment to it, for fine measuring or adjustments. Graduations are for measurements up to 1 in. by thousandths. The shank is ½-in. diam. and 13/16 in. in length. It is suitable for both rugged equipment and severe service conditions

AT LEFT

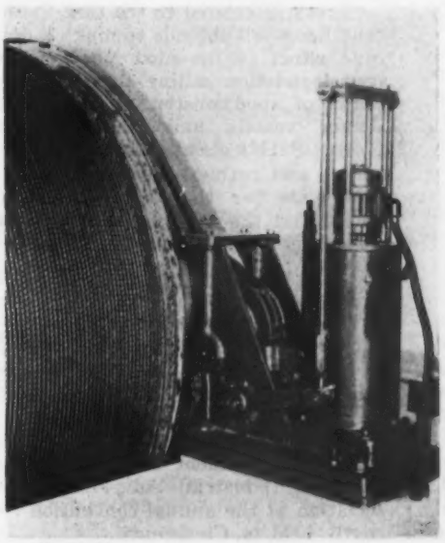
THE Cincinnati manufacturer of this new No 1-12 plain, automatic milling machine stresses the importance of its design for the production of small parts, in either medium or large quantities. Helical gearing is a claimed feature of quietness of drive at the higher spindle speeds. Extreme accuracy of trips in the automatic working cycle of the table is featured. A number of details are given on page 43.

QUICK release for dropping and the small arcing features of this new Ohio lifting magnet and controller were demonstrated by the makers, the Ohio Electric Mfg. Co., Cleveland, at the recent convention of the Association of Iron and Steel Electrical Engineers, held at Cleveland. Magnet improvements cover greater convenience in the disassembly of parts. The new controller has Lavite indestructible arc shields and Thyrite arc suppressor which not only reduces arcing but functions to rapidly reduce the current flow to zero, assuring, it is said, the quick dropping of loads of any kind. The 55 in. magnet pictured here averages 1275 lb. sheet steel stampings scrap per load.



CECOLLOY, used in the frames and anvil of the new model J, Chambersburg board drop hammer, was described in the Sept. 20, 1934, issue of THE IRON AGE. Other features of this new line of hammers are covered on page 43.

TWO types of safety lenses (above) are provided in one frame in this new doubly protective goggle-set described on page 43.



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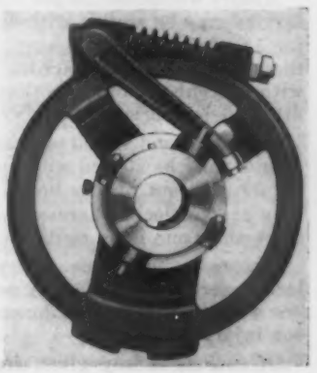
THIS application of thrustor brake is on one of two 13-ft. diam. lifting hoist drums at Boulder Dam. The brake wheel has 12-in. face, 13 ft. 1½ in. diam. See page 46.



AT RIGHT

A NEW series of asbestos-friction clutches, by the Conway Clutch Co., features full-floating friction and non-burning contact for equipment using make and break electric operation. Page 46.

# Electric Thrustor Operates Clutches and Brakes

A NEW electric thrustor, consisting of a self-contained combination of motor-driven centrifugal pump, oil chamber and piston, announced by the General Electric Co., Schenectady, is said to produce a smooth straight line thrust through a definite length of stroke and to be especially suitable for the operation of clutches, brakes, valves, doors, etc. The mechanism is subject to manual, remote or fully automatic control. The new line of thrustors covers a complete range of standard models providing 10 combinations of thrust and stroke ratings varying from 50 to 3200 lb. thrust and from 2 to 16 in. stroke.

The impeller housing of the pump is stationary while a rigid shaft running in ball bearings connects the impeller to the driving motor. Either a.c. or d.c. motor arrangements may be used and interchangeable base plates permit of considerable variation in mounting.

The illustration on page 45 is of a brake installation at Boulder Dam for the control of a 150-ton permanent cableway.

## New Applications Suggested For Torque Motors

IT has recently been emphasized by the Ohio Electric Mfg. Co., Cleveland, that the possibilities and characteristics of the torque motor are not generally known to engineers other than those identified with the elevator companies. These men have been through torque motor applications for switches, controls and various cam-actuated devices, of brakes and of automatic door openers, this largely due to the fact that torque motors can be operated by remote control, are usually more economical in first cost than any system of gears and clutches or air or water cylinders. Such motors are particularly adapted to operate draft controls, wire tension controls, machine feeds, holding or clamping fixtures, timing devices and welding rod feeds.

Depending upon the cycle of operations and the means provided for turning the power off and on the motor, it can be wound to operate for various periods with power on without overheating or burning out as follows: Motors wound for 10 per cent locked service may be stalled with current on for 10 per cent of the time provided they are not locked across the line with the current on for more than 10 min. continuous in any one hour period.

Motors wound for 25 per cent locked service may be stalled with current on for 15 min. out of any hour, provided they are not locked across the line with current on for more than 20 min. in any 1 hr. period.

Motors wound for 50 per cent locked service may be stalled with current on for 30 min. out of any hour, provided they are not locked across the line for more than one hour continuously.

Motors wound for 100 per cent locked service may be left across the line with current on continuously without injury.

Of course, in any given frame size the greatest power can be exerted by the 10 per cent locked service winding and less power for the 25, 50 or 100 per cent service. In other words, the 100 per cent locked service motor is the most expensive.

Torque motors may be wound for all the various multiphase alternating currents, direct current and to a limited extent and at a relatively low torque, for the single phase currents and they may be wound for various speeds from 250 to 1750 r.p.m.

## Rough Duty Clutches Feature Asbestos Friction

THE use of asbestos in friction drive is regarded by the Conway Clutch Co., Cincinnati, as of prime importance in the clutch operation of material-handling equipment employing make and break electric methods.

The new, 5 and 6 series, clutch shown on page 45 features this viewpoint of the company and embodies full-floating friction, non-burning contact, drop-forged actuators, steel drive plate and such factors as will produce powerful action and smooth performance to rough and tough drives.

## British Consider Steel Use in Ship Interiors

THE use of steel in house construction and as an alternative to wood in the internal fittings of ships was discussed at a dinner given by the British Steelwork Association in connection with the International Building Exposition recently held in London. Sir Charles Wright, who presided, said that the achievements of the steel industry on the one side and of the automobile manufacturers on the other had developed an entirely new standard in industrial design.

"In the use of sheet steel," declared Sir Charles, "a new manufacturing technique in pressing, deep stamping, and welding has been evolved, and there are very considerable possibilities in carrying that technique into the field of the oldest and most traditional of all industries—namely, the building industry. The vermin and fireproof house has been given considerable prominence in the slum clearance program, and in such components as doors, window frames, skirting boards, picture rails, steel cupboard equipment, etc., all of which are proof against shrinkage, cracks and crevices, a useful range of products can be put at the disposal of the building authorities."

Francis Lorne, well-known London architect, who designed the British Steelwork Association's stand at the exposition, said that all ages in the past had found an aesthetic treatment for the buildings of their period, but that it still remains largely the problem of the present generation and age to find an aesthetic treatment for steel.

"Most buildings today are constructed to last much too long," Mr. Lorne added. "The average lifetime of a London building is 100 years, and the changes in 100 years in the social and economic life of the people are far too great for any architect to be able to visualize.

"Within the last year or so three large liners have been burnt out, with a considerable loss of human life, largely on account of the fact that so much of the material entering into the decoration was combustible. This is probably not the fault of the companies which built these liners, but largely of the demands of public taste, which likes to have panelled rooms. A Tudor or Jacobean wood-panelled lounge in an ocean-going liner is as much out of place as one can possibly imagine.

"I was interested to see that President Roosevelt intends to make a definite effort in the next Congress to pass legislation calling for the elimination of wood construction in all passenger vessels built in American yards. Such legislation should be universal, and perhaps now is an opportune time for the various Governments and the various underwriting companies to make it so."

The Timken Roller Bearing Co. advertisements in THE IRON AGE brought it an award of first place by the judges for the most effectively conceived and executed industrial advertising campaign of the year in the tool and equipment division of The National Industrial Advertisers Association at the annual convention recently held in Cincinnati.

# THE NEWS OF THE WEEK

## Steel Ingot Production Practically Unchanged During September

PRODUCTION of steel ingots in the United States during September amounted to 1,251,630 gross tons, according to the American Iron and Steel Institute. This compares with 1,363,359 tons in August and with 2,283,079 tons in September, 1933. Approximate daily output, however, declined very little last month, having amounted to 50,065 tons, as against 50,495 tons in the preceding comparable period and 87,811 tons in September, 1933.

The country's available capacity was engaged at 22.74 per cent last month, compared with 22.93 per cent in August and with 40.40 per cent in September of last year.

In the first nine months of 1934 ingot output was 20,268,462 gross tons, compared with 17,189,390 tons in the corresponding 1933 period and with 22,594,079 tons in all of the preceding year.

MONTHLY PRODUCTION OF OPEN-HEARTH AND BESSEMER STEEL INGOTS
(Gross Tons)

Reported for 1933 by Companies Which Made 97.82 Per Cent of 1933 Ingot Output

| 1933 | Open-Hearth | Bessemer | Calculated Output All Companies: Monthly | Calculated Output All Companies: Daily | No. of Working Days | Per Cent Operation‡ |
|---|---|---|---|---|---|---|
| January | 885,663* | 109,000 | 1,016,870† | 39,110† | 26 | 17.99† |
| February | 922,798* | 126,781 | 1,073,012† | 44,709† | 24 | 20.57† |
| March | 784,111* | 94,509 | 898,236† | 33,268† | 27 | 15.30† |
| April | 1,180,823* | 135,217 | 1,345,422† | 53,817† | 25 | 24.76† |
| May | 1,716,425* | 216,841 | 1,976,428† | 73,201† | 27 | 33.68† |
| June | 2,211,652* | 296,765 | 2,564,420† | 98,632† | 26 | 45.37† |
| July | 2,743,326* | 355,836 | 3,168,354† | 126,734† | 25 | 58.30† |
| August | 2,430,663* | 370,370 | 2,863,569† | 106,058† | 27 | 48.79† |
| September | 1,991,204* | 242,014 | 2,283,079† | 87,811† | 26 | 40.40† |
| October | 1,847,690* | 191,673 | 2,084,894† | 80,188† | 26 | 36.89† |
| November | 1,331,029* | 156,939 | 1,521,189† | 58,507† | 26 | 26.92† |
| December | 1,629,495* | 129,334* | 1,798,606† | 71,944† | 25 | 33.10† |
| Total | 19,674,879* | 2,425,779* | 22,594,079† | 72,884† | 310 | 33.53† |

* Revised. † Adjusted.
‡ The figures of "per cent of operation" are based on the annual capacity as of Dec. 31, 1932, of 67,386,130 gross tons for open-hearth and Bessemer steel ingots.

Reported for 1934 by Companies Which Made 99.39 Per Cent of Ingot Production in 1933

| 1934 | | | | | | |
|---|---|---|---|---|---|---|
| January | 1,786,467 | 172,489 | 1,970,979* | 72,999* | 27 | 33.15* |
| February | 1,993,638 | 175,873 | 2,182,826* | 90,951* | 24 | 41.31* |
| March | 2,540,143 | 203,904 | 2,760,888* | 102,255* | 27 | 46.44* |
| April | 2,622,372 | 257,482 | 2,897,529* | 115,901* | 25 | 52.64* |
| May | 3,000,624 | 331,620 | 3,352,695* | 124,174* | 27 | 56.39* |
| June | 2,714,983 | 282,592 | 3,015,972 | 115,999 | 26 | 52.68 |
| July | 1,343,732 | 119,869 | 1,472,584 | 58,903 | 25 | 26.75 |
| August | 1,245,445 | 109,598 | 1,363,359 | 50,495 | 27 | 22.93 |
| September | 1,126,415 | 117,580 | 1,251,630 | 50,065 | 25 | 22.74 |
| Nine Months | 18,373,819 | 1,771,007 | 20,268,462 | 86,989 | 233 | 39.51 |

* Revised.
‡ The figures of "per cent of operation" are based on the annual capacity as of Dec. 31, 1933, of 68,478,813 gross tons for open-hearth and Bessemer steel ingots.

## Manufacturers Protest Federal Operated Units

INDORSING the recent statement of President Roosevelt that unemployment relief should, to the extent possible, be handled by local agencies, the board of the National Association of Manufacturers has expressed opposition to the Federal Government operation of manufacturing plants.

This position was based upon an inquiry submitted to the association's membership which registered strong disapproval of competition with private enterprise which "simply shifts employment from private to public enterprises and serves to retard stable recovery." The association also reported receipt of a petition signed by 17 large trade associations placing them on record against the wide expansion through FERA of Government manufacturing plants into new fields.

## Cost of Living Still Increasing Sharply

THE cost of living of wage-earners increased 1.8 per cent from August to September, the sharpest increase since August, 1933, according to the monthly survey of the National Industrial Conference Board. This advance made living costs in September, 1934, 4 per cent higher than in September, 1933, and 13.3 per cent higher than in April, 1933, when the low point in the cost of living was reached, but 19.6 per cent below the September, 1929, level.

The purchasing value of the dollar was 123.5c. in September as compared with 125.6c. in August, 139.9c. in April, 1933, and 100c. in 1923.

## Discovers New Process For Aluminum Production

DISCOVERY of a new process for the manufacture of aluminum, which, it is claimed, will greatly increase use of this metal in the automobile industry and in other fields, has been announced by Charles B. Bohn, president, Bohn Aluminum & Brass Corpn., Detroit. The result of five years of experimental work, the new process will result in mill expan-

sion at Detroit costing $15,000,000 to $20,000,000.

The process involves the use of alunite ore and is said to make the United States independent of other countries in so far as the raw materials going into the production of aluminum are concerned.

A plant will be constructed immediately at Detroit at a cost of $50,000 to perfect manufacturing operations. Eventually a sheet and wire mill will be built to handle the rolling of the new material on a large scale. A plant will be erected in Utah near the ore deposits. A new organization, financed by the Bohn company, will be established to manufacture and market the new product.

## Secretary Hull to Speak At Foreign Trade Meet

SECRETARY OF STATE CORDELL HULL will be the principal speaker at the world trade dinner of the National Foreign Trade Convention, which will meet this year at the Hotel Commodore, New York, Oct. 31 and Nov. 1 and 2. James A. Farrell, chairman of the National Foreign Trade Council, will preside at the dinner, which will be held on Nov. 1.

It is expected that Secretary Hull will deal with the progress made in carrying out the objects of the Reciprocal Trade Agreement Act, and the promise present reciprocal trade negotiations give of breaking down existing barriers to American trade abroad.

Secretary Roper will be the principal speaker at the opening session of the convention on Oct. 31. The Secretary of Commerce will likely outline the plans of the Administration for aiding American foreign traders, exporters and importers, in overcoming present obstacles to an increasing expansion of overseas commerce.

An order for five separate and complete pressure lubrication systems for steel mill service has been awarded to the De Laval Separator Co., New York, by the United Engineering & Foundry Co., Pittsburgh. The lubrication equipment for each individual system, consisting of a De Laval centrifugal for maintaining the condition of the oil, main oil circulating pump in duplicate, maintenance cycle circulating pump in duplicate, main oil reservoir tank equipped with cooling coils, pressure tank, sight flow and sight feed fittings, as well as electric siren, will be installed for use in conjunction with the new 44-in. blooming mill and 56-in. hot strip mill now being built for the Ford Motor Co. by the United Engineering & Foundry Co.

# Current British Steel Output Is Assured for Remainder of Year

LONDON, ENGLAND, Oct. 9 (*By Cable*).—Pig iron is being well specified and additional furnaces are being prepared for operation. Hematite consumption is heavy, with large deliveries reported. Sheffield, the Midlands and Italy are again buying after a long interval.

Semi-finished steel makers are fairly busy, but are pressing for higher tariff in view of keen Continental competition.

Finished-steel mills are active with more orders for home account and better export demand. Undiminished output is assured until the end of the year.

Tin plate is quiet and new orders for home and export are slow. Inquiries are broadening and may soon result in actual business. Continental iron and steel markets are active. The Japanese Government, as a result of the typhoon catastrophe, has licensed imports of 120,000 tons of iron and steel. Forty thousand tons of sheets and merchant steel angles are already being negotiated with France and Belgium. Great Britain has sold Japan 5000 tons of black sheets.

The International Raw Steel Cartel is maintaining its production program for fourth quarter at 525,000 tons and the International Wire Rod Cartel program is also unchanged at 320,000 tons.

German exporters are stated to be endangering Cartel organization by exceeding quotas, being forced to do so by the Government in view of necessity for increasing foreign exchange supplies. Hamburg exporters are doing considerable business with Far East by barter arrangements.

**British Prices, f.o.b. United Kingdom Ports**

*Per Gross Ton*

| | |
|---|---|
| Ferromanganese, export | £9 |
| Billets, open-hrth. | £5 10s. to £5 15s. |
| Tin plate, per base box | 18s. 2d. |
| Steel bars, open-hearth | £7 17½s. |
| Beams, open-hrth. | £7 7½s. |
| Channels, open-hearth | £7 12½s. |
| Angles, open-hearth | £7 7½s. |
| Black sheets, No. 24 gage | £9 5s. |
| Galvanized sheets, No. 24 gage | £11 5s. |

**Official Continental Prices, f.o.b. Continental Ports**

*Per Metric Ton, Gold £*

Current dollar equivalent is ascertained by multiplying gold pound price by 124.14 to obtain franc equivalent and then converting at present rate of dollar-franc exchange.

| | |
|---|---|
| Billets, Thomas | £2 7s. |
| Wire rods, No. 5 B.W.G. | £4 10s. |
| Steel bars, merchant | £3 5s. |
| Sheet bars | £2 8s. |
| Plates, ¼ in. and up | £4 |
| Plates, 3/16 in. and 5 mm | £4 2s. 6d. |
| Sheets, ¼ in. | £4 7s. 6d. |
| Beams, Thomas | £3 2s. 6d. |
| Angles (Basic) | £3 2s. 6d. |
| Hoops and strip base | £4 2s. 6d. |
| Wire, plain, No. 8 | £5 7s. 6d. |
| Wire nails | £5 15s. |
| Wire, barbed, 4-pt. No. 10 B.W.G. | £8 15s. |

## Industrial Materials Show at New York

THE second annual Industrial Materials Exhibit will be held at the Park Central Hotel, New York, Oct. 15 to 19. A number of companies will have booths at the show, and in addition motion pictures will be shown and lectures given. Industrial motion pictures include the following: "Jewels of Industry," Carborundum Co., Niagara Falls, N. Y.; "Story of Die Casting," Mount Vernon Die Casting Co., Mount Vernon, N. Y.; "Making and Rolling of Steel," Peter A. Frasse & Co., New York; "Making of Hard Fibre," Spaulding Fibre Co., Inc., New York, and "Making and Processing of Seamless Steel Tubing," Peter A. Frasse & Co.

The Bakelite Corpn., Bound Brook, N. J., will offer a lecture on the "Future Possibilities of Bakelite," and the American Felt Co., New York, will present a talk on the "Manufacture and Uses of Felt."

In addition to the above companies other exhibitors at the show will include the following: American Hard Rubber Co., New York; American Steel & Wire Co., Chicago; Apollo Metal Works, LaSalle, Ill.; Boonton Molding Co., Boonton, N. J.; Ericsson Screw Machine Products Co., Brooklyn; Eclipse Air Brush Co., Inc., Newark, N. J.; Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.; Isolantite, Inc., Belleville, N. J.; Maas & Waldstein Co., Newark, N. J.; New England Mica Co., Waltham, Mass.; Parker-Kalon Corpn., New York; Stackpole Carbon Co., St. Marys, Pa.; Superior Sheet Steel Co., Canton, Ohio, and Texas Co., New York.

A meeting of the Plain Washer Manufacturers Association will be held Oct. 15 at the Bismarck Hotel, Chicago. Eugene Caldwell is secretary-treasurer of the association. He also is general manager of the Wrought Washer Mfg. Co., Milwaukee.

# Tool Builders Convene in Atlantic City

## *Hold Joint Meeting with Codified Machine Tool And Forging Machinery Industry at Thirty-third Annual Convention of the N.M.T.B.A.*

EXECUTIVES of the machinery building concerns representing a large majority of the machine tool and forging machinery industry of the United States gathered together in a four-day meeting at Hotel Traymore, Atlantic City, last week. The first two-days' sessions were programmed to emphasize the codified industry viewpoint and experience, while the remaining two days dealt particularly with affairs relating to the National Machine Tool Builders' Association, of which this was the thirty-third annual convention.

Monday was devoted to a meeting of the board of directors of the N.M.T.B.A. in the morning and a meeting of the supervisory agency of the industry in the evening, with a golf tournament as an afternon interlude. Tuesday morning featured the "meeting of the industry," at which Henry Buker, vice-president, Brown & Sharpe Mfg. Co., Providence, R. I., presided. Mr. Buker, who is chairman of the industry's code authority or "supervisory agency," reported upon the work of his agency and its experience in code administration. He laid particular emphasis upon the danger inherent in Executive Order No. 6767, which was the President's invitation or rather authorization to industry to reinaugurate price chiseling up to a 15 per cent limit. "This order," said Mr. Buker, "strikes at the root of the firm price policy which years of experience have proved to be the only sound policy for selling machine tools."

Robert M. Gaylord, president, Ingersoll Milling Machine Co., Rockford, Ill., was asked by the chairman to describe the work of the Durable Goods Industries Committee of which he was a member, as an introduction to the principal speaker. Mr. Gaylord recounted the experience of the committee which was appointed to submit to the President its recommendations for stimulating activity in the heavy industries. This report, as Mr. Gaylord pointed out, represented the constructive suggestions as regards recovery and reemployment of a carefully selected group of outstanding industrialists associated with the "durable" or capital goods industries. This report was submitted to the President on May 14, after weeks of research and study. (*Editor's note*—As yet, its receipt has not yet been even acknowledged, according to our best information.) The speaker then introduced George H. Houston, president, Baldwin Locomotive Works, and chairman of the Durable Goods Industries Committee.

Mr. Houston outlined, in brief, the approach of the committee to its problem and the close relation of that problem to the members of the machine tool and forging industry. With clear and forceful logic that carried conviction to his audience, he dwelt upon the primary recovery requisite to the freest possible flow of goods and services and pointed out the employment hampering effects of factors interfering with this objective.

At the close of Mr. Houston's address, the members, by unanimous vote, authorized a resolution endorsing the report and suggestions to the President made by the Durable Goods Industries Committee on May 14.

Dr. Virgil Jordan, president, National Industrial Conference Board, was the speaker at the formal dinner held on Monday evening. His subject was "The Road Map of Recovery for 1935." Reviewing the events of the past 18 months, Doctor Jordan told his audience that the present road, if we continue following it, must inevitably lead to state capitalism under a political dictatorship. Coining a new word, "Tammunism," to describe what is happing in government and economics, the speaker pointed out that the present methods used in our Government are adapted from the practices of Tammany Hall, and the economic views in vogue in Washington are borrowed from communistic philosophy as applied in Russia.

"We are now at the crossroads," said Doctor Jordan, "and must turn either to the right or to the left. The great danger lies that this crossroad may be passed without turning off." Business men, in the opinion of the speaker, if they become articulate and helpful, can do a great deal at this time to influence the Administration's policies with respect to the road to be chosen.

At the Wednesday morning session, which was the first session of the N.M.T.B.A. convention as such, President Edward A. Muller reviewed the experience of the machine tool building industry with the Government since the passing of the Recovery Act. The treasurer's report was then made by H. S. Robinson, secretary, Cincinnati Shaper Co.

Herman H. Lind, general manager of the N.M.T.B.A., in his report to the convention, emphasized his belief that industry is not safe in planning its future with the expectation that all features of the National Industrial Recovery Act will be eliminated. "I believe," said he, "that the consensus of opinion today would indicate that the labor provisions take the first place in probability of survival; surely some type of collective bargaining. Minimum wage is very certain to remain because it is felt that that is the only protection against sweatshop operation.

"Maximum hours will undoubtedly stay in some form. In our industry, which is so dependent on skilled workmen, limitation of hours and restriction of flexibility of plant operation will bring almost insurmount-

C. J. STILWELL
Newly Elected President of N.M.T.B.A.

### *Elected to N. M. T. B. A. Offices*

*President*, CHARLES J. STILWELL, vice-president the Warner & Swasey Co., Cleveland.

*First vice-president*, NORMAN D. MACLEOD, president and general manager, Abrasive Machine Tool Co., East Providence, R. I.

*Second vice-president*, CLAYTON R. BURT, president and general manager, Pratt & Whitney Co., Hartford, Conn.

*Treasurer*, HUBERT H. PEASE, president, New Britain-Gridley Machine Co., New Britain, Conn.

### *Elected as Directors*

CLAYTON R. BURT, president and general manager, Pratt & Whitney Co., Hartford, Conn.

EUGENE C. CLARKE, president, Chambersburg Engineering Co., Chambersburg, Pa.

HENRY C. PIERLE, secretary and sales manager, R. K. LeBlond Machine Tool Co., Cincinnati.

able obstacles in operation when recovery returns. In this industry there is an apparent shortage of approximately 35 per cent of skilled workmen as compared with 1929, and there was no surplus then. Continuity of production is always dependent upon skilled workmen, not only in our own plants but in the plants of our customers.

"There is a result of the higher wages and shorter hours that is beginning to show its effect on our industry in a substantial way," said Mr. Lind. "Higher wages and shorter hours make necessary cost saving equipment wherever it can be used. That this is taking hold is well illustrated by sales in our own industry this summer. It is particularly pointed for sales in the month of August. Whereas during the month *Business Week's* general index went down 7 per cent, our own increase over July sales was 20 per cent. An analysis discloses that 53 per cent of the companies in our industry increased their business so that it is plain this increase was not the result of a chance order or two.

"Those tools in which substantial advance in productivity has been made in the last few years are in demand and especially those tools that are used in mass production of articles going to individual purchasers or consumers, such as the automobile, refrigerator, washing machine, and the like. The merchandising industries have found that sales of their products are promoted more by low price than by anything else, and that low price under the hour and wage restrictions is only possible through the best methods of processing. That is immediately reflected in our industry, and the consideration that is being given better processing and modern equipment by large numbers of manufacturers indicates that this trend is likely to speed up. Even in the face of general uncertainty the rugged individualism under which our country flourished is beginning to reassert itself by reason of great numbers of industrialists struggling to go forward in spite of every obstacle.

"It seems probable," said the speaker, "that in some agency or other at least a minimum of rules of good business conduct will be laid down in an enforceable way, so that those units of industry that follow fair business practices will not be victimized by those who do not. I believe, therefore, that either through codes, through the Federal Trade Commission, or through some other instrument, the fair trade practices will take some substantial form and substance, at least for those industries that want them.

"Probably the most important attempt at fair trade practices," said Mr. Lind, "is that which is generally found in codes and is most desirable to industry, namely, the open, firm price policy. It is regrettable that the fundamental difference between 'open, firm price policy' and the 'fixing of prices' is not understood and that they are treated by newspaper writers as one and the same thing. Surprisingly, there are others also who do not differentiate between 'open prices and fixed prices.' There is misconception within NRA itself and even among business men.

"Some of the codes provide for restrictions of new equipment and restriction against expansion except as it may be subject to approval of code authorities and the administrator. Provisions of this type certainly should not be included in any form. New methods, new processes, throwing out of the inefficient and the wasteful, is demanded if progress is to be made. If a man has a better idea for a low cost production, no legal obstacle or difficulty should be put in his path. However, there should be available to him the statistics of the industry showing the true condition existing as to capacities and the competitive situation in the market. With this picture available to those willing to invest their money, it is their right and their privilege, and in the public interest, for them to be able to go forward. Otherwise whole industries using obsolete equipment and practicing inefficient methods would remain in that condition indefinitely, contrary to all fundamental principles of progress."

On Thursday morning, at the second session of the convention, Charles J. Stilwell, vice-president, Warner & Swasey Co., Cleveland, was the presiding officer. The first part of the program consisted in the presentation of a symposium on the "Outlook for Foreign Trade," resulting from observations made abroad by Mr. Stilwell, E. A. Drissner, vice-president and chief engineer, National Acme Co., Cleveland; Howard W. Dunbar, manager of grinding machine division, Norton Co., Worcester, Mass., and J. E. Lovely, chief engineer, Jones & Lamson Machine Co., Springfield, Vt. The second part of the program consisted in a description, by Howard W. Dunbar, of the new 18-month apprentice training plan of the Norton Co.

## *Resolution Endorsing Report of Durable Goods Committee*

**WE, the National Machine Tool Builders' Association, assembled in our 33rd Annual Convention, affirm our conviction that National Recovery can be brought about only by reemployment in the Durable Goods Industries.**

**The people of a nation can have no more than they produce. As makers of the basic machines for production, the members of this Association emphasize the fact that the standard of living of a nation is measured by its effective use of machinery. Nowhere else in the world is machinery utilized to the extent that it is in the United States, nowhere else does the average man enjoy as many conveniences and comforts. Witness the 23,000,000 automobiles, the 20,000,000 telephones, the 5,500,000 automatic refrigerators, the millions of radios and the countless other products which the efficiency of the machine has put within reach of the average man; products which are luxuries in other countries.**

**Because of these basic and generally known facts the National Machine Tool Builders' Association by formal resolution hereby endorses the Report to the President of the United States on National Recovery and Employment presented by the Durable Goods Industries Committee on May 14, 1934.**

**We recommend to the President, to congress, and to the recovery administration the most serious consideration of this report and especially the fundamental conditions necessary to recovery and reemployment stated therein. To these fundamentals for the attainment of the best interest of the greatest number we heartily subscribe.**

## New Cutting Machine at Linde Welding Clinic

THE first public demonstration of the Monitor, a new oxy-acetylene cutting machine, was made at the three-day welding clinic held by the Linde Air Products Co. in Cleveland, Sept. 27-29. A cut through 24 in. of metal was made in the slab of that width, which was set on edge, the cut being made at a speed of 4 in. per min.

The Monitor is a portable motor-operated unit for cutting straight lines or circles. It has a centrifugal governor which is calibrated for inches of cutting per minute, the governor being connected with a dual ratio allowing a speed range of from zero to 48 in. per min. The blowpipe may be put in any position. The machine may be used for cutting steel down to ⅛ in. thick. For cutting material 12 in. and over in thickness a lighter blowpipe is used than for cutting lighter steel.

Owing to the large capacity of the oxygen passages in the blowpipe and valves and large capacity regulation the machine is used with a cutting pressure of only 40 lb. per sq. in.

# ... PERSONALS ...

LEO G. SMITH, for many years actively identified with the steel foundry and related industries in the Milwaukee district, has organized the Stainless Steel Castings Co. of America, Inc., with headquarters at 802 First Wisconsin National Bank Building, Milwaukee, and will engage in the manufacture of stainless steel castings at a location to be announced shortly. He will serve as president and general manager of new company and the enterprise will culminate a period of 42 years' association with the castings industry. He began his business career with the International Steam Pump Co., Buffalo, and in 10 years had become assistant cashier and assistant purchasing agent. He then went with the Buckeye Steel Castings Co., Columbus, Ohio, as apprentice molder, serving four years. He next became foreman, green sand department, American Steel Foundries, Sharon, Pa., later becoming general foreman. In 1907 he was made superintendent, Bucyrus Steel Castings Co., Bucyrus, Ohio, and on Jan. 2, 1910, opened the new Steel Foundry of Canada Iron Corpn., at Londonderry, N. S., as manager He went to Milwaukee in February, 1912, as manager of crucible and open-hearth steel foundries of Prime Steel Co., and in 1919 was made president, Modern Steel Castings Co., serving until it ceased operations in 1922. In the last 10 years he has been active in the metal and steel advertising business.

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BONNELL W. CLARK has been appointed vice-president and general manager of the Westinghouse Electric Supply Co., with headquarters at 30 Rockefeller Plaza, New York. He joined the Westinghouse Commercial Investment Co. as special agent in 1925, later becoming assistant to the vice-president, and in 1927 becoming general manager, which position he retained when the company name was changed to Westinghouse Electric Supply Co.

H. N. GANSMAN and R. J. HOLTERMANN have been made vice-presidents of the Westinghouse Electric Supply Co., the former with headquarters at 150 Varick Street, New York, and the latter at the company's San Francisco offices. Mr. Gansman, after his graduation from the University of Pennsylvina, became an apprentice with the Westinghouse Electric & Mfg. Co., East Pittsburgh. In 1920 he was placed in charge of the company's first distributing subsidiary, and in 1931 he came to New York to become general sales manager of the Westinghouse Electric Supply Co. Mr. Holtermann, whose early career was devoted to the electrical supply business on the Pacific Coast, joined the

LEO G. SMITH

Westinghouse interests in 1923, and in 1932 was made district manager for the supply company's entire operations west of the Rocky Mountains.

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COL. JOSEPH RUSTON of Lincoln, England, chairman of the board of Ruston-Hornsby, Ltd., internal combustion engines, and vice-chairman of Ruston-Bucyrus, Ltd., power shovels, has been visiting headquarters of the latter concern's affiliate, Bucyrus-Erie Co., South Milwaukee, Wis. He was accompanied by Mrs. Ruston and they were house guests of William W. Coleman, president of the Bucyrus-Erie Co., and Mrs. Coleman in Miuwaukee.

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RUDOLPH M. KANIK, formerly president and general manager of the Moloch Foundry & Machine Co., Kaukauna, Wis., has become associated with the engineering staff of the A. O. Smith Corpn., Milwaukee, to do general development work. Prior to his association with the Moloch company, Mr. Kanik was identified with the Four Wheel Drive Auto Co., Clintonville, Wis.

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HAROLD SMITH has been elected vice-president of the Westinghouse Electric International Co., with headquarters at 30 Rockefeller Plaza, New York. He joined the Westinghouse Electric & Mfg. Co.'s legal department in 1919, and in 1926 was appointed general solicitor. In 1929 he became vice-president, which office he will hold concurrently with his new position with the Westinghouse Electric International Co. He was formally educated at Northwestern University, Yale University and the University of Chicago.

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GOTTFRID OLSEN, who in recent years has practised consulting engineering in the Chicago area, will leave near the end of this month for Stockholm, Sweden, where he will build and operate a new foundry which will specialize in alloy and high-strength castings. Mr. Olsen was superintendent for 15 years for the Illinois Malleable Iron Co., Chicago, and for three years served as general manager of the Pump Separator Co. at Stockholm, Sweden. He then returned to Chicago to engage in consulting work.

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DEXTER A. TUTEIN has been named representative of the $1,500,000,000 retail solid fuel trade on the NRA general code authority, created Sept. 8, primarily to supervise administration of industries coming under the "basic" code. The general code authority is composed of DR. WILLARD HOTCHKISS, chairman, president of the Armour Institute of Technology; DE LANCEY KOUNTZE, member of the Industrial Advisory Board, and chairman, Devoe & Reynolds Co., paint and varnish manufacturers; the REV. FATHER FRANCIS J. HAAS, former member of the NRA Labor Advisory Board and the National Labor Board; and STACY MAY, assistant director, Rockefeller Foundation, and member of the Consumers' Advisory Board.

Mr. Tutein is the first industry member to be announced. A graduate of the Massachusetts Institute of Technology, where he completed the school of chemical engineering practice, he later served with the United States Naval Reserve Force during the World War. Afterward, he became associated with his father's firm, E. Arthur Tutein, Inc., Philadelphia, engaged in selling pig iron, coal, coke, etc., and also part owner of blast furnace and by-products coke plants.

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JAMES D. COLTMAN, of the Bullard Machine Co., was the guest of the New England Foundrymen's Association on Oct. 10 at its monthly meeting in Boston. He discussed melting and casting problems in the manufacture of high-test cast iron.

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DANIEL B. WORTH, chief engineer of the Whitcomb Locomotive Co., Rochelle, Ill., has joined the engineering department of the Baldwin Locomotive Works, Philadelphia, where he will be identified with the engineering of Baldwin and Whitcomb electric and internal combustion locomotives. EDWARD P. HACHTEL, Whitcomb production engineer, remains at Rochelle, where he will be in charge of inspection and will provide engineering contact with the Whitcomb shops.

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CHARLES L. HYLAND, who for years has been in the sales organization of the Empire Steel Corpn. and Empire Sheet & Tin Plate Co., Mansfield, Ohio, has been made manager of sales of the latter company.

# THE WEEK IN WASHINGTON

# Goldfish Bowl Is Veiled As New NRA Plans Reorganization

By L. W. MOFFETT
Resident Washington Editor
THE IRON AGE

WASHINGTON, Oct. 9.—Modification of NRA policies governing prices and production appears to be a certainty. Radical changes are looked for in some codes, but removal of all price and production control is not contemplated. The thought is to remove all control except that necessary to prevent unfair competition or the waste of natural resources. A balance will be struck where unfair competition may be difficult but NRA apparently feels this may be reasonably determined.

Price control over coal and other natural resources is not to be removed, at least according to the present proposal of those who appear to speak most authoritatively for NRA. Many codes, of course, do not have price control provisions, among them being the steel and automobile codes. The only production control in the steel code relates to blast furnace, Bessemer converter and open-hearth capacity. The automobile code has no production control of any kind. Hence the policy would not directly affect these two codes as to prices but might affect the steel code as to production, a matter which may be in the distant future. What the effect on such major codes as these may be in the way of possible revision of trade practices directly affecting price or production control remains to be seen.

### Policy Attracting Wide Interest

The policy on price and production control gained especially widespread interest the past week. This was because the National Industrial Recovery Board, the new NRA administrative body, started operations. While it appears to have veiled most of the much touted goldfish bowl, it did make public some orders, one of which clearly showed that price control in coal will be continued. A second and perhaps much more important reason for the publicity on price and control policy grew from an extemporaneous address made last Thursday by Donald Richberg before the National Press Club.

Mr. Richberg actually did not say anything which he had not said before but his remarks were widely publicized because they had to do with the future of NRA, and were given especial emphasis by reason of the reorganized set-up. He said in effect that there would be no change in policy from that being pursued under Gen. Hugh S. Johnson. Nevertheless, the policy for a long time has been to lift price and production control and expediting this policy appears to be assured. Previously Mr. Richberg, as director of the National Emergency Committee, said that no sweeping departure in policy would be made without giving business an opportunity to be heard.

His attitude on price and production control was essentially the same as that he voiced recently in an address at Baltimore, in the course of which he attacked the steel code for its intricacy. He indicated that simplification of codes is necessary, and, turning to NRA's future, mentioned the price and production control policy. In that talk he said there has been agreement to eliminate any form of dictatorial control over prices or production. He declared that it is contrary to the public interest to establish any such private or public control "except that necessary to prevent unfair competition or the waste of natural resources."

### Policies In Detail

In much greater detail Mr. Richberg outlined his views in a article in *Fortune* and it was largely from this article that he recited policies in his talk before the Press Club. His speech, however, created a furore among some business men who saw in it, as reported, the withdrawal of all price and production control. Such an eventuality might develop if some officials of NRA had their way. Moreover, the anti-trust laws would be restored to full force. Price competition in its keenest form would be given full sway, prices would be brought down, hours shortened and wages increased.

The policy as stated by Mr. Richberg is accepted as reflecting more nearly that of NRA, though Mr. Richberg has emphasized the fact that the National Industrial Recovery Board will run the revamped NRA. The National Emergency Council will only act in "an advisory capacity" together with its capacity of coordinating the various and sundry alphabetical agencies.

The widely different social and economic views reflected in the personnel of the National Industrial Recovery Board, now formerly christened alphabetically as the NIRB, however, lend doubt as to whether any single individual, even Mr. Richberg, can speak with complete assurance as to its policy, or policies. It is likely that President Roosevelt himself will be called upon to decide conflicts of view within the board. However, the stand-

ing Mr. Richberg has with the administration and his ability and keen powers of perception give his words great weight.

### Not Favorable to Unrestricted Competition

Mr. Richberg's idea of competition does not reflect the old orthodox view of casting aside all control and permitting it to run full force without restriction. His remarks indicate that he thinks there must be a return to the competitive system and that it must be based on fair competition to be brought about by cooperation between the Government and industry. Through this means his speech in substances advocated action to prevent destructive price cutting, and, in some instances, to control production.

"There is no doubt of the necessity, in some specific instances, of preventing destructive price-cutting," said Mr. Richberg. "There is no doubt of the necessity sometimes of putting control on production."

This sentiment is altogether consistent with his repeated statements in the past, calling for an entirely new interpretation of the anti-trust laws, made in the light of present-day economic and industrial conditions. Such a view was expressed by Mr. Richberg in his vigorous defense of the steel code in reply to the attack of the Darrow board.

### Relaxation Imminent

The fact remains, however, that relaxation of price and production control seems to be near at hand. The belief grows that even among some industries these controls have not worked. Morever, public protest against such control undoubtedly has been a factor in tending toward a new policy.

In his article in *Fortune*, Mr. Richberg brought out the thought as follows:

"I think many business men that came down here determined upon production-control and price-control, which they thought were essential to their safety and would produce them profits, have been seriously disillusioned in the course of the year—disillusioned partly as to the practical possibility of carrying out their desires—and disillusioned as to whether they really want them carried out. Therefore, I think, not by a process of sweeping change but by process of working out gradually those problems, industry by industry, it should be possible in the future of NRA to avoid a great many of the complications and difficulties which have been brought into the administration up to date. These difficulties have come, not through the application of some theory by some Government theorist, but because of the pressure of business men themselves to experiment with devices that they thought would do them good and which they have found in many instances are doing them harm."

The arrow indicates L. W. Moffett, Washington representative of Iron Age readers, who is always at the front when big news breaks. This view shows Donald R. Richberg outlining the Government's plans for the NRA.

## *Code Doings and Undoings*

### MANGANESE CASTINGS

An amendment to the steel castings industry code to establish rules of fair trade practice for the manganese steel castings group has been approved. An order consolidating the manganese castings code with the steel castings code was effective Sept. 24. At that time no trade practice rules were included. The approved rules include one which defines most favorable terms of sale permitted for the industry's products. The rules will become effective Oct. 12 unless "good cause to the contrary" is shown before.

### ROOFING AND SHEET METAL CONTRACTORS

Conditional approval of a code budget of $656,667.88 for the roofing and sheet metal contracting division of the construction industry has been announced. The budget covers the period May 25, 1934, to Jan. 25, 1935. Contributions will be at the rate of 1 per cent of current business.

### METAL SPINNING AND STAMPING

Two subdivisions of the fabricated metal products manufacturing and metal finishing and metal coating industry have proposed rules for fair trade practices, to be added to their codes, and a hearing will be held Oct. 15 on the fair trade practice rules proposed for the metal spinning and stamping manufacturing subdivision. Criticisms or objections concerning proposed trade practice rules for the railway brake beam manufacturing subdivision, including a section to require filing of identified lists of prices and terms, must be submitted to room 509, 1518 K Street, N.W., by Oct. 15.

### ANTI-FRICTION BEARING

Objections or suggestions concerning a proposed modification of the anti-friction bearing code, to permit the code authority to prepare a code budget and basis of contribution, must be submitted to room 4023, Department of Commerce Building, before Oct. 17.

### BOILER CODE

Suggestions or objections concerning an order staying an amendment to the boiler manufacturing industry's code, requiring the submission of reports on inquiries and copies of estimates and orders including prices and terms, must be submitted to room 3080, Department of Commerce Building, before Oct. 12. The stay was ordered after a petition asking exemption from the provision had been received from the Wickes Boiler Co., Saginaw, Mich., which claimed that the clause was causing hardship to small enterprises.

### ALUMINUM FORGINGS AND PISTON CASTINGS

Hearings on proposed supplementary codes for the forgings and piston castings divisions of the aluminum industry were held Oct. 3. The code for the forgings division was presented by H. B. Harvey, Harvey Metals Co., Chicago. Sponsor of the code is the Council of the forgings division of the Aluminum Industry, composed of three firms and, claiming to represent over 90 per cent of the business of the division. Only three other members of the industry are known to exist, according to Mr. Harvey.

The piston castings code was presented by H. J. Hater, Aluminum Industries, Inc., Cincinnati, for the council of the piston castings division of the industry. He said there are only 14 firms in the country who may be members of the division and subject to this supplementary code, only seven who definitely are members of the division, and five of them are members of the council. At least 80 per cent of the aluminum piston castings business of the country, Hater said, is done by the council members.

### ACTING DIVISION ADMINISTRATOR

The NRA has announced the appointment of Kilbourne Johnston, son of Gen. Hugh S. Johnson, as acting division administrator of the manufacturing division. The codes in this division include those covering manufactured materials—forging and casting, structural, fabricated and packaging materials, hardware and metal treating—and manufactured products, such as fabricated products.

### CODE AUTHORITIES NAMED

The National Recovery Administration has announced recognition of the following code authority memberships:

**Corrugated Rolled-Metal Culvert Pipe Industry:** E. B. Abbett, Newport Culvert Co., Newport, Ky.; S. R. Ives, Armco Culvert Mfg. Association, Middletown, Ohio; F. A. Kelly, Toncan Culvert Association, Republic Steel Corpn.,

Youngstown; J. H. Robinson, Wheeling Corrugating Co., Wheeling, W. Va.; J. P. Dolan, Penn Culvert Co., Cambridge, Mass.

**Sheet Metal Distributing Trade**, division of the wholesaling of distributing trade: W. H. Bowe, Herrick Co., Boston; Howard Gordon, Gordon Metal Co., Richmond, Va.; Bruce Haines, E. E. Souther Iron Co., St. Louis; C. S. Harper, Harper & McIntire Co., Ottumwa, Iowa; A. W. Howe, J. M. & L. A. Osborn Co., Cleveland; R. H. Lyon, of Lyon, Conklin & Co., Baltimore; B. F. McCreary, Carroll-McCreary Co., Inc., Long Island City, N. Y.; F. J. McNeive, W. F. Potts Sons & Co., Inc., Philadelphia; J. A. Moncrief, Moncrief-Lenoir Mfg. Co., Houston, Tex.; F. O. Schoedinger, Columbus, Ohio; C. I. Sprowl, Mapes & Sprowl Co., Newark, N. J.; Morris Strober, Katzman & Strober, Brooklyn; E. A. Tanner, Milcor Steel Co., Canton Ohio; H. B. Thompson, Conklin Tin Plate & Metal Co., Atlanta, Ga.; Henry E. Usinger, Berger Brothers Co., Philadelphia.

**Replacement Axle Shaft Manufacturing Industry:** W. C. Bulette, Brandt-Warner Mfg. Co., York, Pa.; W. D. Foreman, W. D. Foreman, Chicago; C. H. Davis, Spencer Mfg. Co., Spencer, Ohio; George C. Lees, United States Axle Co., Inc., Pottstown, Pa.; T. R. Navin, Republic Gear Co., Detroit.

## China Interested In Used Railroad Supplies

WASHINGTON, Oct. 9.—The Chinese government combined with a corporation of Chinese bankers is interested in the possibilities of making large purchases of used American railroad equipment, including locomotives, cars, 70 to 85-lb. rails and accessories, according to Commercial Attache Julian Arnold, who is stationed at Shanghai. Mr. Arnold has returned to the United States on one of his periodical trips to get in contact with American business interests in an effort to aid them in developing export markets in China. During his stay he will confer with officials of the American Railway Association regarding the proposed Chinese purchase of American railroad equipment.

"What the Chinese government and the corporation of bankers would buy depends upon the machinery that would be used," Mr. Arnold told THE IRON AGE. "Credit facilities and other factors, of course, would enter into the situation. Eventually, China will require railroad equipment for 100,000 miles of railroad and some of it might be new, depending upon the relation between the price for the new and the used equipment."

Professor A. I. Andrews, at the University of Illinois, has prepared the manuscript for a book on porcelain enamels which is on the way to the publisher. This book should be ready for distribution before the first of the year. It consists of 13 chapters and an appendix, including all of the different phases of enameling, from the raw materials to the properties and tests of the finished product.

# W. Ames & Co., Steel Maker, Attacks NRA Constitutionality

WASHINGTON, Oct. 9.—Directed at Secretary of Agriculture Wallace, Secretary of the Interior Ickes and Thomas H. MacDonald, chief of the Bureau of Public Roads, Department of Agriculture, W. Ames & Co., Jersey City, N. J., makers of concrete reinforcing bars, spikes, bolts, nuts and railroad track supplies, have filed suit in the Supreme Court of the District of Columbia attacking the NRA as being unconstitutional. More specifically the steel company, through Daniel Thew Wright, Washington attorney, brands as illegal an executive order issued by President Roosevelt barring use of Federal funds for the purchase of products other than those meeting all requirements of codes.

The company alleges that the order, issued last March, caused the company to lose at least 1300 tons of steel for road work in New Jersey for part of which the State had obtained PWA funds of which Mr. Ickes as public works administrator has charge. The Department of Agriculture and its Bureau of Public Roads has charge of allocating Federal funds for highway work. The Government defendants are required in an order issued by Justice F. D. Letts to show cause by Oct. 15 why the plaintiff should not be granted the injunction sought so that it might be granted Federal and State contracts on which it is the low bidder.

### Never Signed Code

It is stated in the suit that the company at no time signed the PRA or any code. It attacks as unconstitutional and illegal NRA codes, alleging that they permit code authorities to perform "legislative, judicial and executive functions" and because they regulate matters that are reserved to the States or the people; "require the surrender of liberty and property without due process of law," and because they "require the assignment of rights of action" to the treasurer of the American Iron and Steel Institute or to a representative of the Concrete Reinforcing Steel Institute.

It is further charged that the codes define and make punishable unfair practices without "authority to legislate," because they are granted "inquisitorial powers" in violation of the Constitution; because the codes "purport to reserve to the President the power to rewrite the agreement of one joining the code and then hold such party bound by an obligation he never assumed." It is likewise charged that the codes delegate power to regulate intrastate commerce in violation of the Constitution. The recovery act itself is attacked as "a mere device to coerce this plaintiff, among others similarly situated, to act as Congress and the President wish them to act in respect of matters completely the business of the State government under the Federal Constitution."

The President's order is assailed as illegal because it imposed conditions "not authorized by Congress" and because it discriminates between citizens of the United States.

### Exception Urged by Eastman

It is stated that on April 12, 1934, Joseph B. Eastman, Federal coordinator of transportation, recommended to Gen. Hugh S. Johnson, as NRA administrator, that he make an exception in the specific case of the Ames company from operation of the executive order, but that the administrator denied the exception despite efforts of the company. In his ruling General Johnson, according to the suit, pointed out that Frank Healey, chief Government contracts branch, wrote to Mr. Eastman on Aug. 31, stating it to be the established policy as to exceptions from the Presidential order to grant them only when the work to be performed or material supplied are necessary to the proper functioning of the Government and it is impossible to obtain them from any source which can furnish the certificate of compliance.

In the course of the suit, it was declared the company sought relief from the order.

"Repeatedly," it was stated, "it has been to the NRA and has been to the code authority, has been to the Federal Trade Commission and to the National Recovery Review Board, has protested to the committee on small industries of the NRA, has applied to Secretary Wallace, and while it has been accorded courteous treatment, it has been the courtesy of the executioner."

The company said it had not signed the code because it "ruinously discriminates against it. Because of its refusal to sign the code, it is charged, the defendants have sought to prevent the company from securing any business. The Government is charged with attempting to accomplish this purpose by requiring all recipients of Federal funds to agree not to buy any material from a concern which has not signed the code. This procedure is held to be "an out and out secondary boycott."

**Ducommun Corpn.**, San Francisco and Los Angeles, has been made a warehouse distributer in California for Electrunite mechanical tubing produced by Steel & Tubes, Inc., Cleveland, subsidiary of Republic Steel Corpn.

# "Private Suicide; Not Government Execution" Says Richberg

WASHINGTON, Oct. 9.—"If the steel business is being strangled with red tape and bureaucracy, it isn't a Government execution but just a private suicide."

In this piquant characterization, Donald Richberg in a speech today in Chicago before the Rotary Club, made caustic reply to criticisms which he said are being made by business men of the bureaucratic development of the NRA. Finding these criticisms amusing, he turned again, as he did in his recent Baltimore speech, to jump on the steel code as "probably the longest, most detailed, regulatory code that has been written . . . with literally hundreds of pages of basic code and supplementary regulations."

Alleged bureaucracy in the steel code, which Mr. Richberg asserted had been written almost entirely by the private managers of the industry, was said to be true of practically every other code covering a large industry.

"The complexities, the red tape and the hampering restrictions which business men have devised and written into codes can be written out of codes just as rapidly as they were written in, whenever business men themselves are ready and willing to devise simpler and more effective methods of cooperation," said Mr. Richberg.

His remarks were taken to emphasize again an intention to revamp codes generally, including simplification and the lifting of price and control restrictions. The removal or revision of price and production control provisions, however, will be proposed not in a sweeping manner but "industry by industry." Mr. Richberg previously has made that clear, though his remarks have been misinterpreted to indicate complete removal of both provisions. He has especially stated the necessity of maintaining price and control in natural resource codes, such as coal, oil, lumber and various metals. At the same time Mr. Richberg, executive director of the National Emergency Committee, also pointed out that he was speaking personally and not for the committee. The committee, he has stated, has been set up to coordinate various Federal agencies and to act in an advisory capacity to the President regarding policies of these agencies The National Industrial Recovery Board, he has declared, will make its own policies and recommendations. However, it is firmly believed Mr. Richberg in particular and the committee of which he is a director will be important factors in shaping policies and that their final determination, where major principles are involved, will be reached by the President himself. Or, in any event, will be reached only upon his approval.

In defending the NRA, he stated that its whole course of code making proved the soundness of the emergency program, and, citing gains in employment for different industries which he said resulted from codes, he declared that steel added 75,000 employes with increased payrolls of $6,500,000 per month.

"No outpourings of political claptrap, no learned sophistries of dodo-economists, can dim the lustre of that achievement or make sensible the argument that what was actually done could not be done," declared Mr. Richberg in his best rhetorical form. "But in the process of this economic advance some counter-forces have developed which may have appreciably retarded our recovery and must be squarely met.

Taking this point as a cue Mr. Richberg again outlined his views on the necessity of revision of codes, particularly with regard to price and production control but gave assurance that the purpose is only to restore fair competition and that where safeguards for industry are necessary they will be provided.

Codes, he said, were experiments in industrial self-government which should be given a fair trial as an emergency measure. In many codes, such as the steel code, he declared, approval was given only for a definite trial period. (Editor's note: Subsequently, the steel code was revised on a permanent basis.) Secondly, Mr. Richberg said, no approval of any code was intended to sanction the elimination of fair competition in the production of all the goods that the market would absorb at the lowest prices at which they could be produced and distributed without loss He said it was not his contention that every code has operated in accordance with these principles. It is probable, he continued, despite heated conflicts of opinion, that many codes have provided means of restricting a competition that could honestly be described as fair or unfair according to the economic interest affected. To determine accurately where the public interest lies in such a conflict of private interests was said to be frequently an impossible task. In such circumstances, Mr. Richberg pointed out, it may be the wisest course for the Government to decline to interfere.

"Certainly the American people will not long tolerate any private, monopolistic controls of the levels of production and prices in the industries essential to their welfare," Mr. Richberg declared. "The alternatives should be clearly presented to American business: Individual freedom, the exercise of private initiative and the incentive to private profit can be preserved so long as a fair competitive system is maintained. But when restraints are found necessary—not upon unfair competition—but upon a fair competition in producing as much as the market will absorb at the lowest prices which encourage production, then such restraints can only be imposed, if at all, in the full light of public knowledge and under the continuing supervision and sanction of those officially charged with protection of the public interest.

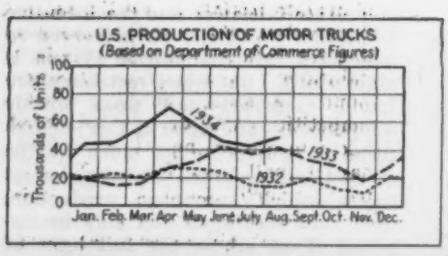
### Labor Relations

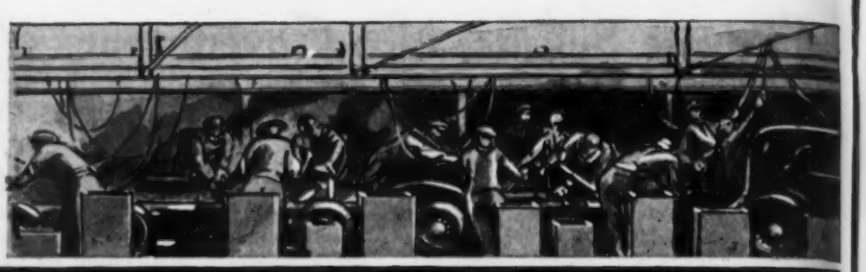
Touching upon labor relations, Mr. Richberg urged settlement of labor disputes through code machinery apparently referring to section 7A of the recovery act. He echoed the President's view that when business men and farmers were demanding the right to organize themselves for protection of their legitimate interests it was natural and right that industrial workers should seek and obtain a statutory declaration of their constitutional right of self-organization to promote their common interests. Mr. Richberg, who called for at least a trial period of industrial peace, said that it is unfortunate that so many employers do not realize that the difficulties which they encounter in dealing with labor organizations are largely the product of their own persistent and often vicious opposition to any independent self-sustaining organization of their workers.

"So long as labor organizations are compelled to fight for the very right of existence they will be led by fighting men, who will be just as hard boiled and ruthless in waging industrial warfare as those who oppose them," declared Mr. Richberg. "The only way to get rid of the cruelties and losses of industrial conflicts is to remove their causes.

"It is not reasonable to expect that peaceful contractual relations can be established and maintained so long as every settlement of a labor dispute provides only an armistice during which each side prepares for the renewal of a never-ending war. There are now provided ample means for the just and peaceful determination of industrial controversies. And, through codes of fair competition, the fear of unfair labor competition should not deter employees from agreements to establish good labor conditions.

"We are in the period of a definite business recovery. The time is ripe for a permanent advance in labor relations. Skeptics will hesitate, stubborn partisans of class interest will hold back and racketeers will sabotage efforts to promote industrial peace. But if the forward-looking leaders in industry and labor will cooperate with the efforts of their government to bring about even a trial period of industrial peace, they will render a great service to all who follow them and to the general welfare."



# THIS WEEK ON THE

# Car Manufacturers Leisurely Preparing For Production of New Models

DETROIT, Oct. 9.

DETROITERS, worked up to a pitch of intense excitement over the Tigers and the possibility that for the first time a world's baseball championship might come to their city, have refused to be bothered much about business in the past week. During the afternoons, beginning on Wednesday, the games between the Tigers and Cardinals took precedence over everything else. Paying $100,000 for the broadcasting rights at the series, the Ford Motor Co. went so far as to close the Rouge plant Tuesday evening for the remainder of the week, ostensibly to permit its employees to attend the games or listen over the radio.

It has been years since Detroit was in such a festive mood. From the time when the games started in the afternoons through the remainder of the day, streets and corridors of office buildings were deserted as everyone not at the ball park crowded around radios to hear the description of proceedings. Mornings were spent arguing over plays in the preceding day's game. So, all in all, it perhaps was just as well that the automobile industry happened to be as near a complete shutdown as it is likely to get this year.

The industry is operating at a rate not much better than 120,000 units a month. In fact, last week's assemblies totaled less than 20,000 cars and trucks, although an increase is anticipated this week through a pick-up in production at Ford's Rouge plant, which will run four or five days.

### Car Manufacturers Spending Little

The outlook at the moment for steel releases and equipment buying at Detroit could hardly be called promising. Car manufacturers seem even less in a hurry than they did a few weeks ago about bringing out 1935 models. They are content to go along leisurely in preparing tools, dies and change-overs in production lines, with slight indication that any major producer will have done more than make a start on new jobs by Nov. 1. The managements of most automobile companies are tightly clutching their purse-strings and spending only the money which they cannot avoid appropriating for improvements and changes.

The reason for this ultra-conservative attitude on the part of an industry which has never been afraid to stake millions seems to be deep concern over the Roosevelt administration's policies. Business nationally isn't much better off than it was in March, 1933, when Mr. Roosevelt stepped into the presidency; with payrolls declining and purchasing power suffering accordingly, sales executives are beginning to wonder what will happen to car sales.

It is difficult to disassociate the slowness of car manufacturers in development of coming models from the well-known plans of union labor leaders to make new radical demands on the industry as soon as production turns up. This year-end, automobile companies will not have any deadline toward which they are aiming in public announcement of their 1935 products. Operations will get under way in more scattered fashion than in several years. Some makers, like Buick, are planning on retaining present models through the peak-selling period next year.

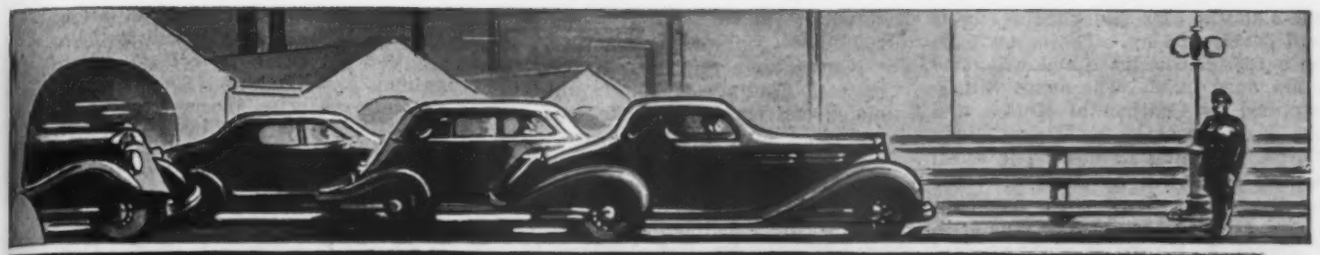
### Pattern Makers Strike Ends

Just now the labor situation is quiescent. Recent happenings scarcely could bring joy to the hearts of union leaders. The pattern makers are said to have decided to return to work with the understanding that the matter of hours and wages be determined by the Detroit Regional Labor Board. Pattern shops, on the other hand, have taken the stand that they cannot submit these questions to arbitration. The upshot probaby will be that the strike will end with shops reemploying at the old scale whatever men they can use. However, these shops have little business on their books and only a portion of the strikers will get immediate work.

It is said that the Mechanics Educational Society has been bumping along on the financial bottom for weeks. This fact alone has deterred it from being very active. In the last two weeks, however, the talk is that a little more money has come into the MES treasury with the result that the high command is in better spirits.

The American Federation of Labor has a new generalissimo along the automotive front. William Collins, head of the AFL's automotive forces since June, 1933, will go to New York to organize federal unions in that district, thereby winning promotion to one of the most responsible positions in the country. His place at the head of the council table of the United Automobile Workers' Federal Union will be assumed by Frank J. Dillon. Mr. Dillon has been in charge of AFL automotive activities in Flint since last February. He served for 14 years as business manager of the Pattern Workers League of North America.

It is at times when strikes are threatened that the AFL membership roster expands most rapidly. Hence the program now reported being mapped out for presentation of new demands, as soon as production of cars reaches the point where a labor tie-up might be effective, is a logical one from the standpoint of the Federation. The extent to which President Roosevelt's



# ASSEMBLY LINE

request for a cessation of strikes will act as a deterrent in the carrying out of these plans remains to be seen.

### AFL Suggests Union Label

Despite its lack of success in attaining major objectives in the automobile industry, the AFL doesn't lack the gall to try to thrust itself on individual manufacturers in unusual roles. The latest story, well authenticated, is that it approached an independent maker with the proposition that it put a union label on its car. The Federation is said to have pointed out that the car builder would profit from this plan by being the first to use the union label, thereby creating for itself a good market among several million union members throughout the country and their sympathizers. This proposal was flatly and quickly rejected by the manufacturer.

### Fall Plans Advancing

Plans of automobile companies are slowly rounding into shape. Chrysler Corpn. is reported to have decided to drop the Chrysler six, retaining only the Airflow to be marketed under the Chrysler name. De Soto, on the other hand, will have a conventionally designed car in addition to the Airflow. Both of the Airflow cars, Chrysler as well as De Soto, will have the front-end design altered somewhat. Chief criticism of the appearance of both cars has been the stubby front. The De Soto Airflow also will be lengthened. Many people who like the Chrysler Airflow, which is on a long wheelbase, have voiced dissatisfaction with the De Soto because it is too short to carry the Airflow lines to the best advantage. Evidently De Soto is cognizant of this criticism and is moving to eliminate it.

It is scarcely a secret that from a profit standpoint the Airflow division of Chrysler Corpn. has given the management a first-class headache all year. Tooling write-offs were extremely large and production below expectations. It is understood that around 13,000 De Soto Airflows and 12,000 Chrysler Airflows have been made this year. Output of Chrysler sixes totaled 22,000 units. In the first nine months of 1934, De Soto registrations amounted to 9677 units, compared with 17,641 units in the same months a year ago. Chrysler registrations were 22,158 units, as against 24,854 last year, but Chrysler dealers sold two or more sixes to every Airflow.

By BURNHAM FINNEY
Detroit Editor, THE IRON AGE

### Chrysler To Make 60,000 Units This Quarter

Plymouth and Dodge will content themselves with minor changes in design, largely confined to the front-end appearance. This will be in accordance with the public statement made recently by Mr. Chrysler that for several years more, at least, low-price cars will be of conservative design. All of the plants of Chrysler Corpn. are reported down and probably will remain closed throughout most of October. Present plans call for production of 60,000 units by Chrysler during the entire fourth quarter, of which about 40,000 will be Plymouths.

Packard is slowly preparing for manufacture of its new light car. Although equipment makers have submitted quotations on new machine tools for work on the transmission and other parts, it is believed that Packard will rebuild existing machinery rather than purchase new tools. The only new equipment purchased on a sizable scale was for the cylinder blockline. Although there was considerable talk about the possibility that the transmission and body for the new car would be made outside, it is understood that Packard will build these units in its own plant. It will be recalled that an official of the Packard company recently said that a higher percentage of parts for the new Packard would be built inside the Packard plant than in the case of any other manufacturer, except Ford.

### Steel Extras Criticized

Automotive steel buyers are privately voicing objections to the new list of extras on wide sheets which apply to 20 gage to 24 gage sheets inclusive. These extras, effective on fourth quarter business, increase the cost of sheets from $1 to $8 a ton, the premium exacted growing progressively higher as the width of the sheet increases. In justification of these advances, sheet makers cite the fact that cost studies made on continuous type mills reveal that in many cases the actual extra expense involved in the manufacture of wide sheets is more than the amount assessed against users in the form of higher extras. Nevertheless, steel buyers are chalking up this new "affront" as one more score to be settled with the steel industry when and if price provisions in the steel code are removed.

### Detroit Notes

The Willys-Overland Co., with orders on hand for 5000 cars, has been granted permission by the Federal court at Toledo to make from 5000 to 15,000 cars. . . . Hudson paid out $41,007,000 for wages, salaries and purchases of materials and equipment during the period from Jan. 1 to Aug. 31 of this year. . . . Federal Motor Truck Co. has begun work on an order for 399 four-wheel drive 2½-ton trucks for the United States War Department, the total amount being $947,591. Fargo Motor Corpn., selling agent for Dodge Brothers, has received an order for 346 trucks totaling $511,789. . . . Chevrolet is reported to have awarded a contract recently to an outside stamping company for half of its gas tank requirements for 1935. . . . Ford will be in the New York automobile show in January. The fact that the show will be a dealer-sponsored affair makes this possible, whereas previously it has been officially under the management of the NACC, of which Ford is not a member.

### New Company Launched on Coast

Gains made this year by the "big three" in the automobile industry haven't discouraged the independents from trying new ventures. Norman De Vaux, former head of the defunct De Vaux-Hall Motor Corpn., has formed the De Vaux Motor Corpn. at Oakland, Cal., and shortly will start production of the De Vaux 666 in the former Durant motors plant in that city. The new car probably will resemble mechanically the former De Vaux car, although it is said that its lines will be somewhat like those of

the LaSalle. Its six-cylinder engine will develop 66 hp. The car will be on a 108-in. wheelbase and will have a standard tread. The motor will be supplied by Continental Motors and the body probably by Hayes Body Corpn. of Grand Rapids. The retail selling price will be $666, delivered on the Pacific Coast, with merchandising activities confined to that area. Clarence A. Hubert is vice-president of the new company in charge of engineering, and F. W. Hohensee, manufacturing manager.

Hupp Motor Corpn. is reported to have taken an option on cars to be built by Willys Overland under the court order granted a week ago. If a poll of Hupmobile dealers is favorable to the proposition Hupp will be in a position to give its retailers a low-price car to supplement the Hupp series of cars. It will be recalled that Hupp recently announced that it would go it alone rather than seek consolidation with other independent companies.

Negotiations still are in progress between Continental Motors and two motor car makers to take over the two lines of Continental cars. The aim in all these cases, of course, is to give dealers a wider variety of products and thereby increase the number of retail outlets as well as strengthen present dealerships.

In the week ended Sept. 29 Plymouth dealers made retail deliveries of 5854 units. During the same week Dodge dealers delivered 4412 units consisting of Dodge and Plymouth passenger cars and Dodge trucks, raising the total for the year to 193,714 units. Buick made retail sales of 5458 cars in September, which was its fourth best month of the year to date. Auburn, stocking dealers with the 1935 line, shipped 1040 cars from its factory last month as against 305 in the same month a year ago.

# Girdler Predicts Expanding Market For Steel—Criticizes Governmental Policies

FUTURE annual production of steel surpassing anything in the history of the industry was predicted by Tom M. Girdler, chairman and president, Republic Steel Corpn., in a talk delivered at the annual banquet of the American Society for Metals in New York, Oct. 5. Broader markets are assured through the development of new types and new applications of steel, Mr. Girdler said.

"Steel is no longer a standardized commodity," he continued, "like sugar or wheat or coal. We have entered into the age of specialized steels. In the future all steels are going to be tailor-made. This will mean that on top of the normal demand for steel, there will be an increased demand which will arise from the necessity of replacing obsolete types of equipment by new equipment manufactured of steel specially adapted to that particular purpose."

Mr. Girdler described uses of new alloy steels in railroad, machine tool, airplane, and various industrial fields. By the use of new alloys, he said, it is possible today to build a freight car which will weigh one-third less, and yet carry more tonnage, than the average car now in use. The steel house, he said, is past the experimental stage and is practical both from a construction and cost standpoint.

Citing the use of stainless steel for dairy machinery, brewery, restaurant and hospital equipment, containers, furniture, refrigerators, store fronts and passenger trains, he indicated that there appears to be literally no limit to the uses to which stainless steel may be put. New broader markets for steel may not be realized, however, until there has been a return of the psychology of confidence and economic stability.

Among factors now retarding confidence, Mr. Girdler listed the failure of the Administration to effect monetary stability, hesitation with respect to long-term financing and distribution of investments, and the labor situation.

"I have no argument to make," he said, "either in favor of inflation or against inflation. The point is, which way are we going, and how far? I want to know what the Government intends to do with my dollar. When I know that, I can plan accordingly.

"The current hesitation with respect to long-term financing is due chiefly to the New Deal philosophy with respect to redistribution of wealth, and discouragement of the opportunity of business to make a profit.

"In an over-zealous attempt of the Administration to spread wages and afford relief to the unemployed," the speaker continued, "stockholders are being penalized beyond all measure.

"The country's millions of stockholders represent the backbone of economic stability. They have been through lean years—and have been surprisingly patient. They have agreed that in the crises through which we have passed wage earners should be taken care of first. They have even accepted without a murmur taxation to pay for the perpetuation of unemployment, the plowing under of cotton, and birth control among pigs. Stockholders sooner or later will assert their rights—and the Administration sooner or later must recognize such rights."

In discussing the labor situation, Mr. Girdler said that difficulties have resulted not from the collective bargaining provisions of NRA, but from the interpretation incorrectly placed upon those provisions by labor union leaders and sympathetic Governmental officials.

"What is needed to remedy this situation," he went on, "is a clear-cut statement from an authoritative Governmental source, correcting organized labor's misinterpretations of the collective bargaining provisions of NRA, and emphasizing the fact that under the law, all employees—union or non-union, in groups or individually—have equal rights and privileges. I think such a move would go far toward preventing strikes and other disorders."

In discussing the steel code, Mr. Girdler said: "I hope the steel industry will never return to cut-throat competition. Such competition carried to its ultimate end means that only the strongest companies can survive, and that would not be a desirable result. The steel code is in substance a practical working arrangement whereby unfair competitive practices are eliminated but nevertheless vigorous competition still exists, which keeps the industry in a healthy condition. In fact the code would represent sound business procedure whether there were any such thing as NRA or not.

"When we have some assurance of monetary stability; when returning confidence has made possible some more long-term financing; when the present wave of labor difficulties has subsided, I believe American business will enjoy a long period of increasing activity and satisfactory profits—profits in which the steel industry and its stockholders are bound to have a substantial share."

# New NRA Board Meets President

WASHINGTON, Oct. 9.—At its first meeting with President Roosevelt, held yesterday at the White House, the newly created National Industrial Recovery Board only discussed NRA problems in general, according to Chairman S. Clay Williams. It did, however, also mention specifically but briefly the question of price and production control. No discussion was given to the matter of industries fixing minimum wages on a yearly basis or to the NRA legislative program, Mr. Williams said. The suggestion of industries providing minimum annual wages was made by President Roosevelt in the course of his recent radio broadcast. It has been widely discussed since then. The system has been adopted in a few industries, but not in any of the basic industries of the country.

# Uncertainty Over Administration Policy Checks Upswing In Buying

## Fear of Continued Labor Troubles Is Also a Discouraging Influence—Ingot Rate Up One-Half Point—Scrap Unchanged

THE gradual upswing in iron and steel demand is losing its force as it encounters increasing caution among buyers. While orders are still growing in number, aggregate bookings in terms of tonnage are showing little or no gain.

Steel production is up two points to 33 per cent in the Wheeling district, one point to 21 per cent in the Philadelphia area, and three points to 24 per cent at Cleveland, but remains unchanged elsewhere. The national average, at 24½ per cent, has risen barely one-half point since a week ago.

UNCERTAINTY regarding Governmental policies, particularly with reference to codes, is the most important deterrent to buying. Although the most recent public statements of Donald R. Richberg indicate that his last week's address in opposition to price control was misinterpreted, the future policy of the Administration remains obscure and the impression that a definite relaxation of code restrictions is due will not down.

The steel code exerts no direct control over prices, but its open-price policy, providing a waiting period between the filing of a new quotation and its going into effect, has protected the industry from the demoralizing effects of secret concessions. Whether a removal of these restrictions would stimulate large-scale purchases is uncertain. But even if more tonnage were placed the reductions in cost accruing from greater volume might be more than offset by price reductions.

FEAR of continued labor trouble is also inhibiting iron and steel buying. The automobile industry, apprehensive of new radical demands by national unions as soon as production turns upward, is no longer pressing its new model programs. As a further precaution against possible labor difficulties it is farming out a maximum number of parts for its new cars among outside suppliers. It is significant that automobile parts makers are among the few groups of buyers that are now increasing their takings of steel.

Farm equipment manufacturers likewise are ordering more material, but demand from agricultural areas for wire products has been disappointing. In the North the season is past for farmer buying of fencing, sheets and nails, but in the South larger purchases are looked for with the distribution of cotton exemption tags.

PIG IRON business, particularly in the Central West, is showing greater improvement than steel bookings. Shipments of pig iron are gaining both because of exhaustion of inventories and a gradual increase in melt. Heating equipment makers and farm implement manufacturers are notably busier and several automotive foundries are preparing to go into production.

Fabricated structural steel awards of 15,700 tons compare with 15,850 tons in the previous week. The largest lettings are 2720 tons for the Krebs Pigment & Color Co., Edge Moor, Del., and 2100 tons for a dam across the Mississippi River at Trempealeau, Wis. An order for 2600 tons of sheet piling for this dam has also been placed. New structural steel projects, at 6400 tons, are the smallest since the last week in January. Plate lettings exceed 1000 tons.

The Navy Department has postponed from Oct. 12 to Nov. 2 the opening of bids on 4000 tons of steel for five destroyers to be built in Navy yards. For 13 Navy vessels placed some time ago with private yards about 6000 tons out of the 20,000 tons of steel to be bought has been purchased.

Railroad buying is at a low ebb, but coal mines, with the approach of winter demands, are showing more interest in light rails and mine ties.

FROM a price standpoint the iron and steel market is without trend. Scrap, traditionally a sensitive barometer, is sluggish, and THE IRON AGE composite for heavy melting steel is unchanged at $9.50 a ton for the third week. THE IRON AGE composites for pig iron and finished steel remain unchanged at $17.90 a ton and 2.124c. a lb. respectively.

Commodity extras on cold-rolled strip steel, as applicable to crown fender steel, lamp steel and tubing and molding quality, have been broadened to include new widths and have been figured against a new base (No. 14 gage) so far as the heavier gages are concerned. In addition new extras for widths and lengths have been announced. The new extras are in effect for this quarter only and will probably be succeeded by a broad revision of the entire extra set-up for strip steel.

# ▲▲▲ A Comparison of Prices ▲▲▲

**Market Prices at Date, and One Week, One Month, and One Year Previous**
**Advances Over Past Week in Heavy Type, Declines in Italics**

## Pig Iron

| | Oct. 9, 1934 | Oct. 2, 1934 | Sept. 11, 1934 | Oct. 10, 1933 |
|---|---|---|---|---|
| *Per Gross Ton:* | | | | |
| No. 2 fdy., Philadelphia | $20.26 | $20.26 | $20.26 | $18.26 |
| No. 2, Valley furnace | 18.50 | 18.50 | 18.50 | 17.50 |
| No. 2 Southern, Cin'ti | 19.13 | 19.13 | 19.13 | 18.13 |
| No. 2, Birmingham† | 14.50 | 14.50 | 14.50 | 13.50 |
| No. 2 foundry, Chicago* | 18.50 | 18.50 | 18.50 | 17.50 |
| Basic, del'd eastern Pa. | 19.76 | 19.76 | 19.76 | 17.76 |
| Basic, Valley furnace | 18.00 | 18.00 | 18.00 | 17.00 |
| Valley Bessemer, del'd P'gh | 20.76 | 20.76 | 20.76 | 19.76 |
| Malleable, Chicago* | 18.50 | 18.50 | 18.50 | 17.50 |
| Malleable, Valley | 18.50 | 18.50 | 18.50 | 17.50 |
| L. S. charcoal, Chicago | 24.04 | 24.04 | 24.04 | 23.54 |
| Ferromanganese, seab'd carlots | 85.00 | 85.00 | 85.00 | 82.00 |

†This quotation is for delivery in South; in the North prices are 38c. a ton under delivered quotations from nearest Northern furnace.

*The switching charge for delivery to foundries in the Chicago district is 60c. per ton.

## Rails, Billets, etc.

| | | | | |
|---|---|---|---|---|
| *Per Gross Ton:* | | | | |
| Rails, heavy, at mill | $36.37½ | $36.37½ | $36.37½ | $40.00 |
| Light rails, Pittsburgh | 35.00 | 35.00 | 35.00 | 32.00 |
| Rerolling billets, Pittsburgh | 27.00 | 27.00 | 27.00 | 26.00 |
| Sheet bars, Pittsburgh | 28.00 | 28.00 | 28.00 | 26.00 |
| Slabs, Pittsburgh | 27.00 | 27.00 | 27.00 | 26.00 |
| Forging billets, Pittsburgh | 32.00 | 32.00 | 32.00 | 31.00 |
| Wire rods, Pittsburgh | 38.00 | 38.00 | 38.00 | 35.00 |
| | Cents | Cents | Cents | Cents |
| Skelp, grvd. steel, P'gh, lb. | 1.70 | 1.70 | 1.70 | 1.60 |

## Finished Steel

| *Per Lb.:* | Cents | Cents | Cents | Cents |
|---|---|---|---|---|
| Bars, Pittsburgh | 1.80 | 1.80 | 1.80 | 1.75 |
| Bars, Chicago | 1.85 | 1.85 | 1.85 | 1.80 |
| Bars, Cleveland | 1.85 | 1.85 | 1.85 | 1.80 |
| Bars, New York | 2.13 | 2.13 | 2.13 | 2.08 |
| Plates, Pittsburgh | 1.80 | 1.80 | 1.80 | 1.70 |
| Plates, Chicago | 1.85 | 1.85 | 1.85 | 1.75 |
| Plates, New York | 2.08 | 2.08 | 2.08 | 1.98 |
| Structural shapes, Pittsburgh | 1.80 | 1.80 | 1.80 | 1.70 |
| Structural shapes, Chicago | 1.85 | 1.85 | 1.85 | 1.75 |
| Structural shapes, New York | 2.05¼ | 2.05¼ | 2.05¼ | 1.95¼ |
| Cold-finished bars, Pittsburgh | 2.10 | 2.10 | 2.10 | 1.95 |
| Hot rolled strips, Pittsburgh | 1.85 | 1.85 | 1.85 | 1.75 |
| Cold-rolled strips, Pittsburgh | 2.60 | 2.60 | 2.60 | 2.40 |

## Finished Steel

| *Per Lb.:* | Oct. 9, 1934 Cents | Oct. 2, 1934 Cents | Sept. 11, 1934 Cents | Oct. 10, 1933 Cents |
|---|---|---|---|---|
| Hot-rolled annealed sheets, No. 24, Pittsburgh | 2.40 | 2.40 | 2.40 | 2.25 |
| Hot-rolled annealed sheets, No. 24, Gary | 2.50 | 2.50 | 2.50 | 2.35 |
| Sheets, galv., No. 24, P'gh | 3.10 | 3.10 | 3.10 | 2.85 |
| Sheets, galv., No. 24, Gary | 3.20 | 3.20 | 3.20 | 2.95 |
| Hot-rolled sheets, No. 10, P'gh | 1.85 | 1.85 | 1.85 | 1.75 |
| Hot-rolled sheets, No. 10, Gary | 1.95 | 1.95 | 1.95 | 1.85 |
| Wire nails, Pittsburgh | 2.60 | 2.60 | 2.60 | 2.10 |
| Wire nails, Chicago dist. mill | 2.65 | 2.65 | 2.65 | 2.15 |
| Plain wire, Pittsburgh | 2.30 | 2.30 | 2.30 | 2.10 |
| Plain wire, Chicago dist. mill | 2.35 | 2.35 | 2.35 | 2.15 |
| Barbed wire, galv., P'gh | 3.00 | 3.00 | 3.00 | 2.60 |
| Barbed wire, galv., Chicago dist. mill | 3.05 | 3.05 | 3.05 | 2.65 |
| Tin plate, 100 lb. box, P'gh | $5.25 | $5.25 | $5.25 | $4.65 |

## Scrap

| *Per Gross Ton:* | | | | |
|---|---|---|---|---|
| Heavy melting steel, P'gh | $10.25 | $10.25 | $10.75 | $12.75 |
| Heavy melting steel, Phila. | 9.50 | 9.50 | 9.75 | 10.25 |
| Heavy melting steel, Ch'go | 8.75 | 8.75 | 8.50 | 9.62½ |
| Carwheels, Chicago | 9.50 | 9.50 | 9.50 | 10.00 |
| Carwheels, Philadelphia | 11.25 | 11.25 | 11.25 | 11.75 |
| No. 1 cast, Pittsburgh | 11.25 | 11.25 | 11.75 | 11.75 |
| No. 1 cast, Philadelphia | 11.75 | 11.75 | 11.75 | 11.50 |
| No. 1 cast, Ch'go (net ton) | 8.00 | 8.00 | 8.00 | 10.00 |
| No. 1 RR. wrot., Phila. | 11.25 | 11.25 | 11.25 | 11.00 |
| No. 1 RR. wrot., Ch'go, (net) | 7.00 | 7.00 | 6.75 | 8.50 |

## Coke, Connellsville

| *Per Net Ton at Oven:* | | | | |
|---|---|---|---|---|
| Furnace coke, prompt | $3.85 | $3.85 | $3.85 | $3.75 |
| Foundry coke, prompt | 4.60 | 4.60 | 4.60 | 4.25 |

## Metals

| *Per Lb. to Large Buyers:* | Cents | Cents | Cents | Cents |
|---|---|---|---|---|
| Electrolytic copper, refinery‡ | 8.75 | 8.75 | 8.75 | 8.75 |
| Lake copper, New York‡ | 9.12½ | 9.12½ | 9.12½ | 8.75 |
| Tin (Straits), New York | 50.75 | 50.95 | 51.37½ | 48.37½ |
| Zinc, East St. Louis | 3.87½ | 3.90 | 4.15 | 4.75 |
| Zinc, New York | 4.22½ | 4.25 | 4.50 | 5.12 |
| Lead, St. Louis | 3.45 | 3.45 | 3.55 | 4.35 |
| Lead, New York | 3.60 | 3.60 | 3.70 | 4.50 |
| Antimony (Asiatic), N. Y. | 9.00 | 8.87½ | 8.62½ | 6.87½ |

On export business there are frequent variations from the above prices. Also, in domestic business, there is at times a range of prices on various products, as shown in our detailed price tables. ‡Blue Eagle copper.

▲ ▲ ▲

# ▲▲▲ The Iron Age Composite Prices ▲▲▲

| | Finished Steel | Pig Iron | Steel Scrap |
|---|---|---|---|
| Oct. 9, 1934 | 2.124c. a Lb. | $17.90 a Gross Ton | $9.50 a Gross Ton |
| One week ago | 2.124c. | 17.90 | 9.50 |
| One month ago | 2.124c. | 17.90 | 9.67 |
| One year ago | 2.015c. | 16.61 | 10.87 |
| | Based on steel bars, beams, tank plates, wire, rails, black pipe, sheets and hot-rolled strips. These products make 85 per cent of the United States output. | Based on average of basic iron at Valley furnace and foundry irons at Chicago, Philadelphia, Buffalo, Valley and Birmingham. | Based on No. 1 heavy melting steel quotations at Pittsburgh, Philadelphia and Chicago. |

| | Finished Steel High | Finished Steel Low | Pig Iron High | Pig Iron Low | Steel Scrap High | Steel Scrap Low |
|---|---|---|---|---|---|---|
| 1934 | 2.199c., April 24 | 2.008c., Jan. 2 | $17.90, May 1 | $16.90, Jan. 27 | $13.00, Mar. 13 | $9.50, Sept. 25 |
| 1933 | 2.015c., Oct. 3 | 1.867c., April 18 | 16.90, Dec. 5 | 13.56, Jan. 3 | 12.25, Aug. 8 | 6.75, Jan. 3 |
| 1932 | 1.977c., Oct. 4 | 1.926c., Feb. 2 | 14.81, Jan. 5 | 13.56, Dec. 6 | 8.50, Jan. 12 | 6.42, July 5 |
| 1931 | 2.037c., Jan. 13 | 1.945c., Dec. 29 | 15.90, Jan. 6 | 14.79, Dec. 15 | 11.33, Jan. 6 | 8.50, Dec. 29 |
| 1930 | 2.273c., Jan. 7 | 2.018c., Dec. 9 | 18.21, Jan. 7 | 15.90, Dec. 16 | 15.00, Feb. 18 | 11.25, Dec. 9 |
| 1929 | 2.317c., April 2 | 2.273c., Oct. 29 | 18.71, May 14 | 18.21, Dec. 17 | 17.58, Jan. 29 | 14.08, Dec. 3 |
| 1928 | 2.286c., Dec. 11 | 2.217c., July 17 | 18.59, Nov. 27 | 17.04, July 24 | 16.50, Dec. 31 | 13.08, July 2 |
| 1927 | 2.402c., Jan. 4 | 2.212c., Nov. 1 | 19.71, Jan. 4 | 17.54, Nov. 1 | 15.25, Jan. 11 | 13.08, Nov. 22 |

# Upswing in Demand Is Halted at Pittsburgh

## Richberg's Recent Address Discourages Buying—Local and Valleys Ingot Rates Unchanged; Wheeling District Output Gains Two Points

PITTSBURGH, Oct. 9.—Aggregate demand for finished steel has been halted in its recent gradual upswing. The hesitancy in consuming industries is believed to have been caused largely by uncertainty surrounding future prices, which was intensified by Recovery Coordinator Richberg's recent address. Large consumers had previously been playing a waiting game, believing that the structure of finished steel prices was by no means firm, and an intimation in the informal address of important changes in code price provisions has strengthened the belief of many consumers that prices will not hold. It is noteworthy, however, that despite unrelenting pressure upon steel producers for lower prices, there have been no drastic revisions in price schedules since early in the third quarter.

Steel makers here are by no means certain that an early departure from code government is in store. Producers, moreover, recognize fully the necessity for maintaining prices in the face of mounting overhead and extremely low operations. Extras have been trimmed in some cases and have been added in other instances, but in most cases this has been done to bring about a more logical relationship between costs and selling prices.

In the Pittsburgh district operations this week are unchanged at 16 per cent. Output in nearby northern Ohio mills and the Valleys is likewise marking time at 26 per cent. Production in the Wheeling district is two points higher at 33 per cent. Finishing mill schedules this week show little change. Structural mills are slightly more active.

Commodity extras on cold-rolled strip steel applying to fender steel, lamp steel and tubing and molding quality have been revised pending board revisions in the set-up on cold-rolled strip extras expected to be established by the end of the fourth quarter.

### Pig Iron

With trading in this market restricted almost wholly to spot buying, volume shows little variation from week to week. Some pressure from large consumers for lower prices has not openly disturbed the price structure, which remains firm. Whether or not revisions in the present price schedules would tempt long overdue buying on the part of basic and Bessemer users is conjectural in the face of extremely low mill operations in this and nearby districts.

### Semi-Finished Steel

Sheet bars for tin plate conversion are in good demand from non-integrated tin plate mills. Detached pipe mills are not taking skelp so regularly as in the past several weeks. Taken as a whole, the semi-finished steel market reflects the sluggishness of general steel operations.

### Bolts, Nuts and Rivets

Bids on a fairly sizable quantity of bolts, nuts and rivets for the Navy construction program were opened at Washington last week, but no awards have thus far been made. Specifications on fourth quarter contracts are considered satisfactory, although producers are not particularly hopeful that tonnage for the quarter will run much heavier than that in the third quarter. This pessimistic outlook is based partly on the absence of important railroad equipment construction.

### Bars

Forward buying for even moderate delivery periods is very scarce. Although consumer interest has expanded, notably from automotive centers, actual bookings are increasing very gradually. Alloy bars are in slightly better favor among automobile makers. A definite fillip to demand is expected by the end of the month when the automotive industry will start assembling new modes in a larger way.

### Reinforcing Steel

Demand is generally unchanged. A seasonal let-down is near, and producers are endeavoring to accelerate deliveries as much as possible on present contracts. Virtually all new specifications are for Federal, State and municipal projects. Private capital is still timid, and in more than a few cases plans for industrial construction have been frightened away by political and business uncertainties. Prices are firm and unchanged.

### Cold-Finished Bars

A fairly general improvement in orders is reported, with demand spread among automobile and accessory, agricultural implement, and office and business machine industries. Further impetus from automotive centers is expected to appear toward the close of the month. The present base of 2.10c., Pittsburgh, is very steady.

### Plates and Shapes

A leading independent mill has received contract for 3365 tons of structural steel for City pier shed No. 32 at New York. The week's structural awards were sprinkled with an encouraging number of private jobs, which individually were small. Fresh specifications are few in number and low in aggregate tonnage. Bids were opened on Oct. 9 at the United States Engineer Office, Wilmington, N. C., on lock and dam No. 2, Cape Fear River, which will require 1600 tons of steel piling.

### Wire Products

Although small-lot orders are more frequent, aggregate tonnage is still abnormally low. Wire mill schedules are consequently erratic and few mills are scheduled above 20 per cent. Manufacturers' wire and spring wire are a shade more active as a result of increased automotive demand. The merchant trade continues quiet, with replenishment buying by jobbers not important thus far in the quarter. In order to meet low-priced mail order house competition, carload prices are now applied to less-carload shipments of wire nails.

### Tubular Products

A fair demand continues for oil country goods and standard pipe. No new line projects of specific character have appeared in recent weeks. A few small gas lines entailing limited quantities of pipe are the only projects within the line pipe category. Plant repairs have helped to drive in small-lot business for boiler tubes, while railroad buying of locomotive boiler tubes is on a reduced basis. Pipe mills in this district are barely averaging 25 per cent.

### Sheets

The volume of business in most grades of sheets has declined noticeably in the past week. Producers can trace the decrease chiefly to general business uncertainty. The outlook for automotive buying, however, has not been dimmed, and a definite pickup within the next few weeks from that source is considered certain. In view of the irregular flow of daily tonnage it is difficult to gage accurately weekly operating schedules. A fair aver-

age for this week is placed at around 23 per cent.

### Tin Plate

Mixed trends in demand rule in this market. Some producers are benefiting from anticipatory specifications, while others are still able to hold a fair rate on daily miscellaneous releases. On the whole, average operations this week will hold at 45 per cent. The amount of anticipatory tonnage is possibly being limited, since large tin plate consumers are not generally willing to follow custom this year.

### Strip Steel

Commodity extras on cold-rolled strip steel, as applicable to crown fender steel, lamp steel and tubing and molding quality, have been broadened to include widths of 2 in. to 23 15/16 in., instead of 12 1/16 to 23 15/16 in. under the old setup. Bases for light and heavy gages on the commodity extras applying to the foregoing qualities have been established at 2.90c. for 14 gage and 3.30c., Pittsburgh, for 20 gage, the latter base being unchanged from the previous setup. These changes are applicable only to fourth quarter and will probably be succeeded by broad revisions in the setup on cold-rolled extras which are being studied by a committee appointed by the American Iron and Steel Institute. Some correlation between cold-rolled strip and cold-finished sheets is under consideration. Meanwhile standard cold-rolled strip is quotably unchanged at 2.60c., and hot rolled strip at 1.85c., Pittsburgh. Demand has tapered off, but reports from automotive centers indicate fairly heavy requirements may be placed late in October. Miscellaneous demand is rather listless.

### Coal and Coke

The only encouraging feature in this market is a continued improvement in demand for domestic sized fuel. Movement of industrial sizes is keeping step with the slow pace of manufacturing activity in this district. Recent concessions permissible under special code authority have been discarded. Right of price concession on water gas coke to meet anthracite coal competition is one of the chief cancellations.

### Scrap

Prices are showing some strength at the recently reduced levels. Blast furnace grades are an exception. Although a few minor transactions are reported consumer demand continues to be very apathetic. Mills still are liquidating scrap piles so far as possible and replenishment purchases are usually based upon the same hand-to-mouth buying policy ruling in finished steel products. Until steel mills accumulate healthier backlogs there is very little prospect of general scrap buying. No. 1 steel on the recent Pennsylvania Railroad list was sold at around $10.75.

# Accidents in Press Shops Can Be Reduced By Orderliness

FIFTY per cent of the accidents in a press shop are caused by poor housekeeping and can be prevented. A well-kept house is the cheapest and most satisfactory way of reducing accidents, in the opinion of G. F. Oliver, factory manager, J. W. Murray Mfg. Co., Detroit, who discussed safeguards in heavy and light press operations before the Power Press Section of the National Safety Council at its 23d annual safety congress held in Cleveland last week.

Last spring when production in his company plant was crowded with orders for automobile body stampings Mr. Oliver said he looked the press shop over and his description of what he saw indicated that he found it in a pretty bad mess from the standpoint of orderliness. Stampings were piled up everywhere and the floor was littered. At that time operating costs were going up and the men's earnings were going down. He immediately did some very thorough housecleaning. When the house, in this case the press shop, was in good order operating costs went down, men's earnings were increased 20 per cent, the company was able to cut off a night shift, minor accidents were reduced 76 per cent and the shop was made a safer place in which to work.

The Murray shop is 650 ft. long and 60 ft. wide. Hot rolled sheets handled by an electric crane go from the storage yard to the pickling room at one end of the shop and then down to the other end for a start on the press operations. Material handling was a problem. His first move was to place an 8-ft. aisle down the center of the plant, taking up 5000 sq. ft. of floor space. This was marked with an ⅛ in. x ⅜ in. steel strip which was nailed to the wood block floor, the ends being welded together so that they would not turn up. The aisle markers were painted orange and also the electric trucks used in handling. Some small presses were moved and the wood horses used in handling dies to the presses were replaced with steel horses. Routing of trimmings was changed. After the changes were made the shop, he said, was clean and orderly and had more room than before.

Mr. Oliver emphasized the need of keeping the floor around presses smooth and clean to make it safer both for the press operators and for truck operations. One of the hazards of press operations that he mentioned was due to the stacking up of large pieces at the end or at the side of the press. Unless they are properly stacked, he said, they may slide and cause injuries.

Smaller dies in the Murray plant are handled in a lift truck, but large dies weighing up to 20 tons are delivered with an overhead crane and the placing of these large dies in a press is a dangerous operation. This is done by placing one end on a horse and the other on the bed of the press and then raising the end on the horse and pushing the die over the bed until it is in place.

Every accident should be investigated carefully, said the speaker, who also warned that fear should not be put in the minds of workmen. A feeling of safety makes for safety, he said. It is bad psychology to keep telling a man that this or that is dangerous.

In the Murray plant every press operator is made responsible for the cleanliness of his press and the floor around it. The speaker said that in the Oldsmobile plant cleaning costs had been reduced from $80,000 to $12,000 a year by making the men responsible for keeping their machines and the floor around them clean. Sawdust is spread around the presses in the Murray plant to keep the floor from becoming slippery, but the company is now testing a nonskid material for this purpose. One man stated in the discussion that he is using roofing paper on the floor around the presses and other machines with satisfactory results. This has been used three months and has not yet had to be replaced. Another called attention to the cast tread similar to a stair tread that has been brought out for this purpose.

## Detroit Buyer Develops Lower Scrap Price

DETROIT, Oct. 9.—The local scrap market still reflects lack of interest on the part of consumers. The Detroit district steel plant has purchased a small tonnage of scrap at 25c. a ton less than it last paid. However, prices which dealers are paying have not changed.

Three phases of transportation and their relation to the purchasing of raw and finished materials are to be featured at a dinner meeting of the Chicago Purchasing Agents' Association on Thursday, Oct. 11, at the Blackstone Hotel. The subject of waterways will be discussed by Lachlan Macleay, executive vice-president, Mississippi Valley Association; truck deliveries, by Edward E. Arkin, president, Chicago Motor Express, Inc., and the railroads, by Samuel O. Dunn, editor, *Railway Age*.

# 778 HEADS in One Order

**528 Heads, 108 in. dia., ⅜ in. thick, 1½ in. straight flange**
**204 " 102 " " ⅜ " " 1½ " " "**
**46 " 96 " " 5/16 " " 1½ " " "**

This order, handled in Bethlehem Steel Company's Flanging Shop, totaled 460 tons.

The location of the Bethlehem Flanging Shop, with plate mills and the open-hearth furnaces of a large steel plant right at hand, makes it possible to fill large or small orders in any grade of steel with great speed.

Even when the necessary steel plates have to be rolled, it is not uncommon for Bethlehem to complete and ship orders of substantial size for flanged and dished heads within from 24 to 36 hours after the order has been placed.

**BETHLEHEM STEEL COMPANY**

GENERAL OFFICES BETHLEHEM STEEL BETHLEHEM, PA.

# BETHLEHEM STEEL PLATES

# Steel Rate Is Unchanged In Chicago District

## Implement Plants and Automobile Parts Makers Take More Steel—Foundry Melt Rising—Scrap Uncertain

CHICAGO, Oct. 9.—The rate of ingot production in this district remains unchanged at a shade above 26 per cent of capacity, but the variation from the beginning to the end of each week is slightly more pronounced. This week promises to follow the lead of the first week in the month when mills gained two points above their initial rate only to drop the two points at the opening of the new seven-day period.

High spots in the market are lacking and none seems to be ready to break in the near future. Automobile manufacturers are starting to farm out parts for new models. There is good evidence that this practice will be carried out on a much broader scale as a protective measure against interruptions of supplies because of labor disputes. Although not all farm implement manufacturers are registering gains in production, still it does not appear that the industry as a whole is losing any ground. Tractor plants are slightly busier.

New buying of finished steel products remains at recent levels, but specifications are growing. It is interesting to note that this gain is due almost wholly to the use of bars and that automobile parts makers and farm implement plants account for the bulk of the heavier shipments.

The scrap market stands between the start of speculative buying and the low rate of scrap used by heavy consumers. Railroad offerings are unusually heavy and dealers are lowering their offers.

### Pig Iron

The melt continues to creep upward and the near future is promising since several automobile foundries expect to go into production on new models by the middle of the month. Machine tool orders at Rockford have stimulated the foundry business at that center and many farm implement manufacturers are ordering out more castings. Stove foundries throughout the Middle West are operating at close to capacity.

### Rails

The only bright spot in this market is a report that a Western railroad has obtained Government funds, which will be used not only to rehabilitate rolling stock but also to lay rails that were taken on recent contract and are now in storage. This matter of the new rails that railroads have not put in track is one of the major disturbing elements in this market. Track accessory shipments have dwindled to an unusually low point.

### Sheets

Current specifications are not permitting operations to climb above the 30 per cent of capacity mark. Automobile manufacturers are buying cautiously and are limiting shipments to actual needs. Orders from miscellaneous sources indicate that they are for the most part only fill-in requirements.

### Cold-Rolled Strip

Tonnages being released are light in the aggregate and they are widely scattered. Some business is coming from automobile manufacturers, who remain cautious and thereby leave sellers without clear vision as to what may be expected in the near future.

### Wire Products

Sellers are more or less reconciled to a dull and drab October. New buying is desultory, but specifications average quite even when one week is compared with another. This situation is shown by operations, which still stand at 25 per cent of capacity, the average rate that has been maintained for the last 45 to 60 days. There is no trend now apparent that gives a clue to what the future holds. Many farm areas are on the verge of entering the winter season, and they must soon, of necessity, be removed from the market, which they have neglected in spite of Government money that has been made available.

### Plates

Contracts have been awarded for the Trempealeau, Wis., dam. Of the 2100 tons of structural material required about 1000 tons consists of plates. Railroad shops and car manufacturers are doing very little work, and their combined tonnages give little support to the market.

### Bars

This week's orders to bar mills are almost wholly responsible for the moderate gain in aggregate steel specifications. It should be noted also that automobile parts makers and farm implement manufacturers, the latter being the most important, are furnishing the bulk of the increase in bar tonnage. It is interesting to observe that automobile plants are changing their practice in that they are again turning to outside suppliers of parts. They are influenced by two considerations: (1) The possibility of lower costs, and (2) a greater degree of protection from labor disturbances.

### Structural Material

Awards total about 9000 tons and include 2200 tons for a bridge in California and 2100 tons for a dam across the Mississippi River. Inquiries are limited to about 5000 tons, half of which is for a highway bridge in Missouri. Bids will be opened on the second Mississippi River dam on Oct. 18, and the third unit will come out for figures early in December.

### Reinforcing Bars

Bids have been opened on the Trempealeau, Wis., dam, which is to be built across the Mississippi River. This project will require 320 tons of reinforcing bars. An order has been placed for 275 tons for a private project at Battle Creek, Mich. Other awards are for public work, such as 370 tons for the Ashland Avenue Bridge, Chicago, and 365 tons for the Sanitary District of Chicago. Fresh inquiries are light, both in number and size, and most sellers view the future with some degree of uncertainty.

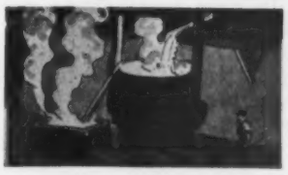
### Cast Iron Pipe

This market is quite active on previously reported PWA work, but new projects, both private and public, are scarce. Mitchell, S. D., and Mount Sterling, Ill., have placed tonnages, and Chicago has opened bids on 320 tons of 36-in. pipe. General contracts have been awarded by Michigan City, Ind., and Madison, Wis. Crown Point, Ind., where a filter plant is to be built, will readvertise. Some cast iron pipe will be needed for the Mississippi River dams, but most of the tonnage will consist of special fittings.

### Scrap

Developments in this market are not of great moment. Heavy melting steel is still quotable at $8.50 to $9 a ton, at which range it probably has less strength than a week ago. There are several contradictory factors, any one of which might become paramount and pull the market either up or down. Mill operations are no higher and the outlook in that direction is not promising. On the other hand, willingness to add to stock piles, possibly as a speculative move, is more pronounced. There is a better movement of foundry grades. Local mills have sold rejected plates for shipment to Japan.

# Further Moderate Gain in Bookings at New York



**Improvement Due Largely to an Increase in the Number of Orders—Foreign Competition Again Felt**

NEW YORK, Oct. 9.—Steel orders are increasing in number, but the gain in tonnage has been slight. Bookings from sheet jobbers are notably heavier, suggesting that stocks are being exhausted, but even in this case new commitments are extremely conservative. With protection against advances the rest of the quarter and with the future of the price provisions of the steel code increasingly uncertain, buyers can see no advantage in placing anything except their immediate needs.

Government-financed work continues to supply the industry with much needed tonnage. The steel for the 13 navy vessels recently awarded to private yards is being purchased. Approximately 18,000 tons of plates, shapes and bars, besides an attractive tonnage of stainless steel, is involved. The Socony-Vacuum Oil Co. has awarded repairs to a tanker requiring 260 tons of plates to the Federal Shipbuilding & Dry Dock Co. Inquiries for oil storage tanks and refinery buildings for Argentina and Sumatra are still pending.

Low prices on foreign steel are again a cause for worry in this district, particularly among jobbers. Some warehouses are seriously considering stocking foreign steel unless domestic mills assist them in coping with this competition.

### Pig Iron

During the past seven-day period sellers in this district disposed of about 1200 tons of iron, most of which will be shipped during the current month. This compares with 1400 tons sold a week earlier and new bookings of 1650 tons a fortnight ago. The situation is unaltered in that foundries are limiting their purchases to immediate needs. These needs are not large, as foundry operations are at a low level and the trade expects no marked improvement this quarter.

### Reinforcing Steel

The Department of Parks, New York, drew lots for the awarding of 1000 tons of bars and Carroll-McCreary Co. was the fortunate distributer bidding. Other awards consist of 225 tons of mesh to American Steel & Wire Co. for highway work in Ontario County, N. Y., and 300 tons in Oswego County to Kalman Steel Corpn. Bids were closed today at Albany on 400 tons of bars and mesh for miscellaneous road work in New York State. The 680 tons required for a market building in the Bronx has not yet been awarded and the disposition of 2000 tons for the Federal Building in New York will not be announced for two more weeks.

### Scrap

Several Eastern Pennsylvania foundries have purchased moderate amounts of cast grades, but otherwise the domestic market supplied by this territory continues to be utterly lifeless. The steel operating rate in eastern Pennsylvania has advanced to over 20 per cent, but brokers look for little or no improvement in the scrap situation there until operations go over 30 per cent. Export demand, however, is still most encouraging. Foreign buyers are entering new commitments and brokers are purchasing steadily against old orders. At present three boats are loading heavy melting steel at Jersey City for shipment to England, the Continent and Japan. This demand is even drawing material from eastern Pennsylvania and prices are firm. On occasions more than $8 and $6.50 have been paid for small lots of No. 1 and No. 2 heavy melting steel respectively, but there has been no general mark-up for truck lots. Cast scrap is quotably firm for both domestic and foreign deliveries, and all other grades are considered nominal in the absence of significant transactions.

## Baseball Halts Trade at St. Louis

ST. LOUIS, Oct. 9.—Business in all lines of the iron and steel trade has been in a state of demoralization because of the World Series. Talk of baseball and arranging for hotel reservations and tickets to the games monopolized time to the detriment of business.

Scattered orders of a carload to 100 tons of pig iron continue to reach the makers in increasing numbers. September business was considerably ahead of August, and October's orders indicate further gains. Stove foundries are at present working at the peak of the year, and foundries generally report better business.

A slight pickup was reported at the start of the week in most lines of finished steel. The orders generally were for fill-in purposes. Warehouse trade opened up better in October than at the start of the preceding month. Illinois will open bids today for highway projects requiring 100 tons of reinforcing bars.

Scrap prices are unchanged. Dealers are more hopeful of a pickup in a few weeks, and are holding their stocks of scrap. Offerings are very light.

## Sheet Demand Off At Cincinnati

CINCINNATI, Oct. 9.—Failure of the President in his broadcast to clear the fog from labor and code skies has depressed sheet steel demand. While mill operators indicate that the attempt to clarify New Deal policies was technically encouraging, the lack of definite assurances from high Governmental sources as to the future course of the NRA has renewed consumer reluctance to cover beyond urgent needs. Bookings have dipped, ending an encouraging steady upward trend of more than a month. Automotive purchasing is almost at a standstill, while other sheet users are giving closer scrutiny to their order books than to shop needs.

Pig iron buyers are taking material only as the need arises. Since code provisions offer no incentive to anticipatory buying, orders are small, ranging from a single car to 100 tons. Furnaces at Hamilton and Columbus, however, are still in blast, Hamilton being on merchant iron while Columbus is alternating between malleable and basic. Despite lack of active buying, furnace stocks of merchant iron are not so large as to raise fear of overstocking. Automobile foundries are almost at a standstill, although stove and jobbing foundries are maintaining a moderate melt.

Foundry coke ordering, following affirmation of third quarter prices for the remainder of this year, is held to 30-day commitments.

Activity in scrap has been limited to the sale of several cars of distress clippings. Prices, while undisclosed, are reported to have been unusually attractive to buyers. Dealers' bids are unchanged.

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The Edward G. Budd Mfg. Co., Philadelphia, has placed an order with the Timken Roller Bearing Co., Canton, Ohio, for bearings and boxes to be used on the two new high-speed stream-lined "Zephyr" trains which are being built for the Chicago, Burlington & Quincy Railroad. The two trains will operate on high-speed schedule between Chicago and the Twin Cities.

# Production Recovers Recent Loss in Cleveland Area

**Ingot Output Rises Three Points to 24 Per Cent of Capacity — Outlook for Automotive Demand Improves**

CLEVELAND, Oct. 9.—While the upward trend in the demand for finished steel which was in evidence for two or three weeks seems to have been checked, sentiment among producers who depend upon the automotive industry for much of their business has improved because of the expectation that motor car manufacturers will place considerable tonnage for new models within the next two weeks. Recent business from that source has been mostly for fill-in purposes. However, some good orders for stampings and forgings for new models have been placed in this territory, which have stimulated the buying of steel in moderate lots. The volume of alloy steel business the past week was the best in six weeks.

Ingot output in the Cleveland-Lorain territory this week recovered the loss it sustained last week, being at 24 per cent of capacity. The three-point gain was due to the starting up of another local open-hearth furnace.

Metal-working plants outside of the motor car industry show little, if any, increased activity and orders for steel from these miscellaneous sources are still confined to small lots. The possibility that the price control structure will be modified or abandoned is resulting in hesitancy among many buyers about making commitments for steel not needed immediately. These feel that should code control of prices be abandoned there will be an immediate downward price revision.

Pig iron continues to move in increasing volume. While the melt has improved somewhat in some industries, the gain is due largely to depletion of old stocks.

### Pig Iron

Demand still shows an upward trend. Shipments by a leading producer during the first week of October were 100 per cent larger than during the corresponding period of September. While most sales were for small lots, an order for 500 tons was placed during the week by an automotive foundry. With one exception, this is the only sizable purchase since June. Another order was for 300 tons. Heating equipment manufacturers are more active than other consuming industries. A little new demand has developed from agricultural implement manufacturers.

### Strip Steel

While some new business came from the automotive industry in the Detroit territory and from stamping plants in the Cleveland territory making automobile stampings, sales in the aggregate were light during the week. However, feeling among producers seems to be more optimistic than for some time, owing to the belief that round tonnages will be placed shortly by the automobile manufacturers. While Chevrolet was expected to make a distribution of orders for the fourth quarter during the week, reports indicate that no large purchases have as yet been made by this company. Activity among other consumers is rather spotty. Mills have placed in effect the new list of commodity prices for the automotive trade and for manufacturers of formed tubing and molding covering cold-rolled strip 2 in. to 23 15/16 in. wide in heavier than 14 gage or lighter than 22 gage, and lamp stock quality strip in widths of 12 1/16 in. to 23 15/16 in. The new prices were adopted in order that narrow strip may carry prices comparable with cold-rolled sheets. On the heavier sizes the new gage extras represent price reductions of $8 a ton. Fender stock bases of 3.30c. for 20 gage and 2.90c. for 14 gage are used, the latter base being substituted for the present 10 gage base.

### Sheets

Following the placing of some fair-sized orders recently by motor car parts manufacturers, the market was dull the past week. New consumer demand is lacking.

### Bars, Plates and Shapes

An award of 400 tons of shapes and reinforcing bars has been made by the Lincoln Electric Co., Cleveland, for plant extension. With little public work coming out in Ohio, inquiry in the construction field is very light. While there is little activity in merchant bars, substantial orders for alloy steel bars came from two or three forge shops in this territory during the week. The Willys-Overland Co., Toledo, has been authorized by the Federal Court to build 5000 to 15,000 passenger cars and trucks, steel for which is expected to be placed early next month. Plates are in light demand.

### Scrap

Local mills have heavy stocks and may need no additional scrap this year. Stocks in dealers' yards are also rather large. Activity is confined to small purchases by dealers for Youngstown district delivery. While one mill in that district released limited quantities of scrap this week another held up shipments. For delivery in the Youngstown district, dealers are paying $10.25 for No. 1 heavy melting steel, $9.25 for No. 2 and $9.50 for hydraulic bundles. The market has a weak tone, although quotations are unchanged.

## Buffalo Scrap Prices Firmer

BUFFALO, Oct. 9.—While no important sales of scrap have been made during the past week, the terms of the smaller transactions indicated greater firmness in prices. Several sales of No. 1 machinery cast have been made at $10.75 to $11. Some malleable sales have been made at $11. Machine shop turnings have been sold at $5.50. These sales were all made at above the quoted prices and seem to be evidence that the market has touched its bottom, inasmuch as operations are not heavy. Movement of scrap out of this district and from upper Lake ports through here and destined for export is undoubtedly contributing to the firmer market. As reported previously in THE IRON AGE, the movement of scrap out of central New York territory that has heretofore acted as a steady feeder for mills operating here, coupled with the fact that even railroad lists are going into the export trade, is a distinct innovation, and is paving the way for an eventual shortage of old material in this district.

Mill operations show no change. Lackawanna's Bethlehem plant is operating five open-hearths; Republic, three and Wickwire-Spencer Steel Corpn. one. The Seneca sheet division of Bethlehem is running at 15 per cent of capacity.

Pig iron sales are low, with no large inquiries.

## Bids on Navy Steel Postponed

WASHINGTON, Oct. 9.—The Navy Department has postponed from Oct. 12 to Nov. 2 the date for opening bids for approximately 4000 tons of steel for five destroyers to be built in Navy yards. No reason for the postponement was given.

# Steel Ingot Production Rises at Philadelphia

**Output Now at 21 Per Cent of Capacity, Although Finished Steel Demand Shows No Further Gain—Navy Bids Postponed**

PHILADELPHIA, Oct. 9.—Demand for the heavier finished steel products is holding its own in this territory, although producers of sheets and light plates report a falling off in business in some instances. Orders generally are confined to very small quantities, the only sizable tonnage before the trade consisting of Navy business.

Some of the private builders who shared in the recent naval vessel awards are now placing the steel required, but a nearby yard is deferring purchases in lieu of the completion of final plans. The Navy Department has postponed until Nov. 2 the taking of bids on plates, sheets, bars and strip steel to be used in the construction of five destroyers at Navy yards. About 4400 tons of steel is involved. It is understood that the new bids will call for prices on both carload and less-than-carload quantities.

Railroad buying is still negligible and carriers continue to defer announcement of their fall and winter repair programs. Automotive body and stamping companies are preparing for fall activity and die and pattern shops are fairly busy. However, demand for sheets and strip steel is still confined principally to stove makers and radio manufacturers.

Steel ingot production in the Philadelphia territory has risen one point to 21 per cent of capacity, largely because of more activity on the part of the leading interest.

### Pig Iron

The foundry melt in this district is just about holding its own and the pig iron business shows no change. Consumers are drawing upon stocks in many instances and carload lots for immediate shipment constitute the bulk of orders.

### Bars, Plates and Shapes

The American Bridge Co. has been awarded 2700 tons of structural shapes for the Krebs Pigment & Color Co. buildings at Edge Moor, Del., and the Phoenix Bridge Co. has taken 800 tons for a bridge in Massachusetts. No other sizable structural jobs are before the trade and reinforcing bar demand is confined to highway work. The taking of bids on 4400 tons of plates, bars, sheets and strip to be used by the Navy Department for the construction of five destroyers in its own yards has been postponed from Oct. 12 to Nov. 2. Private yards have placed part of the steel needed for the vessels they will construct, but considerable additional tonnage remains to be contracted for. Demand for plates for boilers remains quiet.

### Sheets

No particular change in demand is noticed and the orders booked by some makers this month have hardly equalled the corresponding September level. The only important consuming industries which are at all active in this territory are stove and radio makers. Buying by warehouses is confined to small lots for fill-in purposes as general inventory levels have not been substantially reduced.

### Imports

The following iron and steel imports were received here last week: 4000 tons of chrome ore from British South Africa, 100 tons of ferromanganese from England, 26 tons of steel bands, 25 tons of structural shapes, 22 tons of steel bars and 9 tons of diamond plates from Belgium; 10 tons of structural shapes, 7 tons of steel bands and 4 tons of steel bars from France, and 2 tons of steel tubes and 1 ton of steel forgings from Sweden.

### Scrap

With no mill buying of consequence reported, the market is being supported largely by export demand. Fortunately for dealers, this business is well sustained and foreign buyers continue to show interest in United States purchases. Foundry demand is fair and dealers report that many melters are increasing their percentage of scrap because of the comparatively high price of pig iron. Scrap prices are unchanged and strictly nominal on many grades.

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## Sheet and Wire Orders Better in South

BIRMINGHAM, Oct. 9.—Current demand for pig iron and steel is still irregular and limited. The average foundry is buying pig iron on a spot basis. A few have made forward commitments, but not for their entire requirements this quarter. The present tendency, with the price pegged at $14.50, is to order iron only as needed. Yard stocks of the foundries, also, are still a definite factor in the present dull market. There has been no recent change in furnace operations, five stacks being active. Four of these are on foundry iron and one on basic.

Sheet and wire products tonnage has picked up a little, but is still far from the volume expected by this time. A delay in the distribution of cotton exemption tags has retarded the marketing of cotton up until now, and this has held back country buying. Other lines are extremely slow.

Six open-hearth units out of 24 were worked last week, and the same schedule is being followed this week.

The pressure pipe situation continues close to the favorable levels of August and September. October is expected to be as good as last month. A number of lettings, mostly PWA projects, are scheduled. This week's lettings include 680 tons for the East Bay District at San Francisco and about 1300 tons for Fredericksburg, Tex.

Last week it was necessary for the Governor of Georgia to send National Guard troops to Rome, Ga., as a result of the stove foundry strike that has been in progress since July 21. The trouble has largely centered around four foundries. Several have not been affected. Shipments from the district are said to be increasing.

The Kilby Car & Foundry Co., Anniston, is installing a new electric steel furnace.

The Seaboard Air Line has awarded 800 tons of bridge material to the Virginia Bridge & Iron Co. for a bridge over the James River near Richmond. The steel will be fabricated at Birmingham.

Pullman Car & Mfg. Co. has just about finished its Central of Georgia contract for 200 hopper cars and will finish the Seaboard order before Dec. 1, the deadline for final deliveries. Seaboard ordered 800 cars, 300 of which are being built at Richmond.

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**Oxyacetylene Cutting Machines.**—Air Reduction Sales Co., Lincoln Building, New York. Booklet describing and illustrating the new BD No. 1 Tractograph. A variety of cuts showing standard and heretofore difficult operations as well as other gas cutting devices are instructively presented.

# Prices of Finished Steel and Iron Products

## BARS, PLATES, SHAPES

### Iron and Steel Bars

*Soft Steel Base per Lb.*

| | |
|---|---|
| F.o.b. Pittsburgh | 1.80c. |
| F.o.b. Chicago | 1.85c. |
| F.o.b. Gary | 1.85c. |
| F.o.b. Duluth | 1.95c. |
| Del'd Detroit | 1.95c. |
| F.o.b. Cleveland | 1.85c. |
| F.o.b. Buffalo | 1.90c. |
| Del'd Philadelphia | 2.09c. |
| Del'd New York | 2.13c. |
| F.o.b. Birmingham | 1.95c. |
| F.o.b. cars dock Gulf ports | 2.20c. |
| F.o.b. cars dock Pacific ports | 2.35c. |

*Rail Steel*

(For merchant trade)

| | |
|---|---|
| F.o.b. Pittsburgh | 1.70c. |
| F.o.b. Chicago | 1.75c. |
| F.o.b. Gary | 1.75c. |
| F.o.b. Moline, Ill. | 1.75c |
| F.o.b. Cleveland | 1.75c. |
| F.o.b. Buffalo | 1.80c. |
| F.o.b. Birmingham | 1.85c. |
| F.o.b. cars dock Gulf ports | 2.10c. |
| F.o.b. cars dock Pacific ports | 2.25c. |

*Billet Steel Reinforcing*

(Straight lengths as quoted by distributers)

| | |
|---|---|
| F.o.b. Pittsburgh | 2.05c. |
| F.o.b. Chicago | 2.10c. |
| F.o.b. Gary | 2.10c. |
| Del'd Detroit | 2.20c. |
| F.o.b. Cleveland | 2.10c. |
| F.o.b. Youngstown | 2.10c. |
| F.o.b. Buffalo | 2.10c. |
| F.o.b. Birmingham | 2.10c. |
| F.o.b. cars dock Gulf ports | 2.45c. |
| F.o.b. cars dock Pacific ports | 2.45c. |

*Rail Steel Reinforcing*

(Straight lengths as quoted by distributers)

| | |
|---|---|
| F.o.b. Pittsburgh | 1.90c. |
| F.o.b. Chicago | 1.95c. |
| F.o.b. Gary | 1.95c. |
| F.o.b. Cleveland | 1.95c. |
| F.o.b. Youngstown | 1.95c. |
| F.o.b. Buffalo | 1.95c. |
| F.o.b. Birmingham | 1.95c. |
| F.o.b. cars dock Gulf ports | 2.30c. |
| F.o.b. cars dock Pacific ports | 2.30c. |

*Iron*

| | |
|---|---|
| F.o.b. Chicago | 1.80c. |
| F.o.b. Terre Haute, Ind. | 1.75c. |
| F.o.b. Louisville, Ky. | 2.10c. |
| F.o.b. Danville, Pa. | 1.80c. |
| F.o.b. Berwick, Pa. | 1.80c. |

### Cold Finished Bars and Shafting*

*Base per Lb.*

| | |
|---|---|
| F.o.b. Pittsburgh | 2.10c. |
| F.o.b. Chicago | 2.15c. |
| F.o.b. Gary | 2.15c. |
| F.o.b. Cleveland | 2.15c. |
| F.o.b. Buffalo | 2.20c. |
| Del'd Detroit | 2.30c. |
| Del'd eastern Michigan | 2.35c. |

* In quantities of 10,000 to 19,999 lb.

### Fence and Sign Posts

*Angle Line Posts*

*Base per Net Ton*

| | |
|---|---|
| F.o.b. Pittsburgh | $50.00 |
| F.o.b. Chicago | 50.00 |
| F.o.b. Duluth | 51.00 |
| F.o.b. Cleveland | 50.00 |
| F.o.b. Birmingham | 53.00 |
| F.o.b. Houston | 59.00 |
| F.o.b. cars dock Pacific ports | 68.00 |

### Plates

*Base per Lb.*

| | |
|---|---|
| F.o.b. Pittsburgh | 1.80c. |
| F.o.b. Chicago | 1.85c. |
| F.o.b. Gary | 1.85c. |
| Del'd Cleveland | 1.985c. |
| F.o.b. Coatesville | 1.90c. |
| F.o.b. Sparrows Point | 1.90c. |
| Del'd Philadelphia | 1.985c. |
| Del'd New York | 2.08c. |
| F.o.b. Birmingham | 1.95c. |
| F.o.b. cars dock Gulf ports | 2.20c. |
| F.o.b. cars dock Pacific ports | 2.35c. |
| Wrought iron plates, f.o.b. P'gh | 3.00c. |

### Floor Plates

| | |
|---|---|
| F.o.b. Pittsburgh | 3.35c. |
| F.o.b. Chicago | 3.40c. |
| F.o.b. Coatesville | 3.45c. |
| F.o.b. cars dock Gulf ports | 3.75c. |
| F.o.b. cars dock Pacific ports | 3.90c. |

### Structural Shapes

*Base per Lb.*

| | |
|---|---|
| F.o.b. Pittsburgh | 1.80c. |
| F.o.b. Chicago | 1.85c. |
| Del'd Cleveland | 1.985c. |
| F.o.b. Buffalo | 1.90c. |
| F.o.b. Bethlehem | 1.90c. |
| Del'd Philadelphia | 2.005c. |
| Del'd New York | 2.0523c. |
| F.o.b. Birmingham (standard) | 1.95c. |
| F.o.b. cars dock Gulf ports | 2.25c. |
| F.o.b. cars dock Pacific ports | 2.35c. |

### Steel Sheet Piling

*Base per Lb.*

| | |
|---|---|
| F.o.b. Pittsburgh | 2.15c. |
| F.o.b. Chicago | 2.25c. |
| F.o.b. Buffalo | 2.25c. |
| F.o.b. cars dock Gulf ports | 2.60c. |
| F.o.b. cars dock Pacific ports | 2.60c. |

## SHEETS, STRIP, TIN PLATE TERNE PLATE

### Sheets

*Hot Rolled*

*Base per Lb.*

| | |
|---|---|
| No. 10, f.o.b. Pittsburgh | 1.85c. |
| No. 10, f.o.b. Gary | 1.95c. |
| No. 10, del'd Detroit | 2.05c. |
| No. 10, del'd Phila. | 2.14c. |
| No. 10, f.o.b. Birmingham | 2.00c. |
| No. 10, f.o.b. dock cars Pacific ports | 2.40c. |

*Hot-Rolled Annealed*

| | |
|---|---|
| No. 24, f.o.b. Pittsburgh | 2.40c. |
| No. 24, f.o.b. Gary | 2.50c. |
| No. 24, del'd Detroit | 2.60c. |
| No. 24, del'd Phila. | 2.69c. |
| No. 24, f.o.b. Birmingham | 2.55c. |
| No. 24, f.o.b. dock cars Pacific ports | 3.05c. |
| No. 24, wrought iron, Pittsburgh | 4.30c. |

*Heavy Cold-Rolled*

| | |
|---|---|
| No. 10 gage, f.o.b. Pittsburgh | 2.30c. |
| No. 10 gage, f.o.b. Gary | 2.60c. |
| No. 10 gage, del'd Detroit | 2.70c. |
| No. 10 gage, del'd Phila. | 2.79c. |
| No. 10 gage, f.o.b. Birmingham | 2.55c. |
| No. 10 gage, f.o.b. dock cars Pacific ports | 3.10c. |

*Light Cold-Rolled*

| | |
|---|---|
| No. 20 gage, f.o.b. Pittsburgh | 2.95c. |
| No. 20 gage, f.o.b. Gary | 3.05c. |
| No. 20 gage, del'd Detroit | 3.15c. |
| No. 20 gage, del'd Phila. | 3.24c. |
| No. 20 gage, f.o.b. Birmingham | 3.10c. |
| No. 20 gage, f.o.b. dock cars Pacific ports | 3.50c. |

*Galvanized Sheets*

| | |
|---|---|
| No. 24, f.o.b. Pittsburgh | 3.10c. |
| No. 24, f.o.b. Gary | 3.20c. |
| No. 24, del'd Phila. | 3.39c. |
| No. 24, f.o.b. Birmingham | 3.25c. |
| No. 24, f.o.b. dock cars Pacific ports | 3.70c. |
| No. 24, wrought iron, Pittsburgh | 4.95c. |

*Long Ternes*

| | |
|---|---|
| No. 24, unassorted 8-lb. coating f.o.b. Pittsburgh | 3.40c. |
| F.o.b. cars dock Pacific ports | 4.10c. |

*Vitreous Enameling Stock*

| | |
|---|---|
| No. 20, f.o.b. Pittsburgh | 3.10c. |

*Tin Mill Black Plate*

| | |
|---|---|
| No. 28, f.o.b. Pittsburgh | 2.75c. |
| No. 28, Gary | 2.85c. |
| No. 28, cars dock, Pacific Coast ports | 3.35c. |

### Tin Plate *Base per Box*

| | |
|---|---|
| Standard cokes, f.o.b. P'gh district mill | $5.25 |
| Standard cokes, f.o.b. Gary | 5.35 |
| Standard cokes, f.o.b. cars dock Pacific ports | 5.90 |

### Terne Plate

*(F.o.b. Pittsburgh)*

(Per Package, 20 x 28 in.)

| | |
|---|---|
| 8-lb. coating I.C. | $10.00 |
| 15-lb. coating I.C. | 12.00 |
| 20-lb. coating I.C. | 13.00 |
| 25-lb. coating I.C. | 14.00 |
| 30-lb. coating I.C. | 15.25 |
| 40-lb. coating I.C. | 17.50 |

### Hot-Rolled Hoops, Bands, Strips and Flats under ¼ in.

*Base per Lb.*

| | |
|---|---|
| All widths up to 24 in., P'gh | 1.85c. |
| All widths up to 24 in., Chicago | 1.95c. |
| All widths up to 24 in., del'd Detroit | 2.05c. |
| All widths up to 24 in., Birmingham | 2.00c. |
| Cooperage stock, Pittsburgh | 2.10c. |
| Cooperage stock, Chicago | 2.20c. |

### Cold-Rolled Strips

*Base per Lb.*

| | |
|---|---|
| F.o.b. Pittsburgh | 2.60c. |
| F.o.b. Cleveland | 2.60c. |
| Del'd Chicago | 2.88c. |
| F.o.b. Worcester | 2.80c. |

*Fender Stock*

| | |
|---|---|
| No. 14, Pittsburgh or Cleveland | 2.90c. |
| No. 20, Pittsburgh or Cleveland | 3.30c. |
| F.o.b. Worcester | 3.70c. |

### Hot-Rolled Rail Steel Strips

*Base per Lb.*

| | |
|---|---|
| F.o.b. Pittsburgh | 1.70c. |
| F.o.b. Chicago | 1.75c. |
| F.o.b. Birmingham | 1.85c. |

## WIRE PRODUCTS

(Carload lots, f.o.b. Pittsburgh and Cleveland.)

*To Manufacturing Trade Per Lb.*

| | |
|---|---|
| Bright wire | 2.30c. |
| Spring wire | 3.20c. |

*Chicago prices on products sold to the manufacturing trade are $1 a ton above Pittsburgh or Cleveland.*

*To Jobbing Trade*

Qualified jobbers are entitled to a reduction of 20c. a 100 lb. from the base price on carload shipments to stock, and of 10c. a 100 lb. on less-carload shipments to stock.

*Base per Keg*

| | |
|---|---|
| Standard wire nails | $2.60 |
| Smooth coated nails | 2.60 |
| Galvanized nails: | |
| 15 gage and coarser | 4.60 |
| 16 gage and finer | 5.10 |

*Base per 100 Lb.*

| | |
|---|---|
| Annealed fence wire | $2.45 |
| Galvanized fence wire | 2.80 |
| Polished staples | 3.30 |
| Galvanized staples | 3.55 |
| Barbed wire, galvanized | 3.00 |
| Woven wire fence, base column | 63.00 |

*Chicago and Anderson, Ind., mill prices are $1 a ton over Pittsburgh base (on all products except woven wire fence, for which the Chicago price is $2 above Pittsburgh); Duluth, Minn., and Worcester, Mass., mill prices are $2 a ton over Pittsburgh (except for woven wire fence at Duluth which is $3 over Pittsburgh), and Birmingham mill prices are $3 a ton over Pittsburgh.*

*On manufacturers' wire prices at Pacific ports are $9 above the Pittsburgh base. On high-carbon spring wire, prices at Pacific ports are also $9 above Pittsburgh. On wire nails, barbed wire, staples and fence wire, prices at Houston, Galveston and Corpus Christi are $6 a ton over Pittsburgh, while New Orleans and Pacific Coast prices are $8 over Pittsburgh. Exception: on fence wire Pacific Coast prices are $11 a ton above Pittsburgh.*

### Wire Hoops, Twisted or Welded

*Off List*

| | |
|---|---|
| F.o.b. Pittsburgh | 35 and 2½ off |
| F.o.b. Chicago | 35 off |

### Bale Ties, Single Loop

*Base per Net Ton*

| | |
|---|---|
| F.o.b. Pittsburgh | $63.00 |
| F.o.b. Chicago | 64.00 |
| F.o.b. Duluth | 65.00 |
| F.o.b. Cleveland | 63.00 |
| F.o.b. Birmingham | 66.00 |
| F.o.b. cars dock Houston, Galveston, Beaumont, Orange or Corpus Christi, Tex. | 72.00 |
| F.o.b. cars dock Pacific ports | 74.00 |

## STEEL AND WROUGHT PIPE AND TUBING

### Welded Pipe

**Base Discounts, f.o.b. Pittsburgh District and Lorain, Ohio, Mills**

F.o.b. Pittsburgh only on wrought iron pipe.

*Butt Weld*

| Steel Inches | Black | Galv. | Wrought Iron Inches | Black | Galv. |
|---|---|---|---|---|---|
| ⅛ | ....51½ | 29½ | ⅛ | +91½ | +138 |
| ¼ to ⅜ | ....53½ | 33 | ¼ & ⅜ | +1½ | +21½ |
| ½ | ....58½ | 47 | ½ | ....31½ | 15 |
| ¾ | ....62 | 52 | ¾ | ....36½ | 20½ |
| 1 to 3 | ....64 | 55 | 1 & 1¼ | ....39½ | 25½ |
| | | | 1½ | ....43½ | 29 |
| | | | 2 | ....41½ | 26 |

*Lap Weld*

| | | | | | |
|---|---|---|---|---|---|
| 2 | ....60 | 51 | 2 | ....37 | 22½ |
| 2½ to 3 | ....63 | 54 | 2½ to 3½ | 38 | 25 |
| 3½ to 6 | ....65 | 56 | 4 to 8 | ....40 | 28½ |
| 7 and 8 | ....64 | 54 | 9 to 12 | ....38 | 24½ |
| 9 and 10 | ....63½ | 53½ | | | |
| 11 and 12 | 62½ | 52½ | | | |

*Butt Weld, extra strong, plain ends*

| | | | | | |
|---|---|---|---|---|---|
| ⅛ | ....48½ | 33½ | ⅛ | +13 | +45½ |
| ¼ to ⅜ | ....51 | 38 | ¼ & ⅜ | +2½ | +31½ |
| ½ | ....56½ | 47½ | ½ | ....32½ | 17½ |
| ¾ | ....61 | 52 | ¾ | ....37½ | 22½ |
| 1 to 3 | ....63 | 55 | 1 to 2 | ....43½ | 29 |

*Lap Weld, extra strong, plain ends*

| | | | | | |
|---|---|---|---|---|---|
| 2 | ....58 | 50 | 2 | ....40 | 26 |
| 2½ to 3 | ....62 | 54 | 2½ to 4 | 45½ | 33 |
| 3½ to 6 | ..65½ | 57½ | 4½ to 6 | 45 | 33½ |
| 7 and 8 | ..64½ | 54½ | 7 & 8 | ..46 | 33 |
| 9 and 10 | ..63½ | 53½ | 9 to 12 | ..41½ | 30 |
| 11 and 12 | 62½ | 52½ | | | |

On standard steel pipe an extra 5% off is allowed on sales to consumers while two 5's off apply on sales to jobbers. On less-than-carload shipments prices are determined by adding 20 and 25% and the carload freight rate to the base card. On structural steel pipe the base card is reduced 2 points and two 5's off are allowed to consumers and three 5's off to jobbers.

Note—Chicago district mills have a base two points less than the above discounts. Chicago delivered base is 2½ points less. Freight is figured from Pittsburgh, Lorain, Ohio, and Chicago district mills, the billing being from the point producing the lowest price to destination.

### Boiler Tubes

*Seamless Steel Commercial Boiler Tubes and Locomotive Tubes*

(Net base prices per 100 ft. f.o.b. Pittsburgh, in carload lots)

| | | Cold Drawn | Hot Rolled |
|---|---|---|---|
| 1 in. o.d. | 13 B.W.G. | $ 8.60 | $7.32 |
| 1¼ in. o.d. | 13 B.W.G. | 10.19 | 9.36 |
| 1½ in. o.d. | 13 B.W.G. | 11.26 | 10.32 |
| 1¾ in. o.d. | 13 B.W.G. | 12.82 | 11.64 |
| 2 in. o.d. | 13 B.W.G. | 14.35 | 13.04 |
| 2¼ in. o.d. | 12 B.W.G. | 16.00 | 14.54 |
| 2½ in. o.d. | 12 B.W.G. | 19.29 | 17.54 |
| 2¾ in. o.d. | 12 B.W.G. | 20.45 | 18.59 |
| 3 in. o.d. | 12 B.W.G. | 21.45 | 19.50 |
| 3¼ in. o.d. | 11 B.W.G. | 25.22 | 23.00 |
| 3½ in. o.d. | 11 B.W.G. | 27.00 | 24.62 |
| 4 in. o.d. | 10 B.W.G. | 33.60 | 30.54 |
| 4½ in. o.d. | 10 B.W.G. | 41.08 | 37.36 |
| 5 in. o.d. | 9 B.W.G. | 51.56 | 46.87 |
| 6 in. o.d. | 7 B.W.G. | 79.15 | 71.96 |

Extras for less-carload quantities:

| | |
|---|---|
| 25,000 lb. or ft. to 39,999 lb. or ft. | 5 % |
| 10,000 lb. or ft. to 24,999 lb. or ft. | 12½% |
| 2,000 lb. or ft. to 9,999 lb. or ft. | 25 % |
| Under 2,000 lb. or ft. | 40 % |

*Hot-Finished Lapweld Steel Pressure Tubes*

(Net base prices per 100 ft., f.o.b. Pittsburgh, in carload lots)

| | | |
|---|---|---|
| 1½ in. o.d. | 13 B.W.G. | $ 9.71 |
| 1¾ in. o.d. | 13 B.W.G. | 11.36 |
| 2 in. o.d. | 13 B.W.G. | 12.88 |
| 2¼ in. o.d. | 13 B.W.G. | 13.79 |
| 2½ in. o.d. | 12 B.W.G. | 16.58 |
| 2¾ in. o.d. | 12 B.W.G. | 17.56 |
| 3 in. o.d. | 12 B.W.G. | 18.33 |
| 3¼ in. o.d. | 11 B.W.G. | 21.56 |
| 3½ in. o.d. | 11 B.W.G. | 23.15 |
| 4 in. o.d. | 10 B.W.G. | 28.66 |
| 4½ in. o.d. | 10 B.W.G. | 35.22 |
| 5 in. o.d. | 9 B.W.G. | 44.25 |
| 6 in. o.d. | 7 B.W.G. | 68.14 |

Quantity Extras:

| | |
|---|---|
| 40,000 lb. or ft. | base |
| 25,000 lb. or ft. to 39,999 lb. or ft. | plus 5 % |
| 10,000 lb. or ft. to 24,999 lb. or ft. | plus 12½% |
| 2,000 lb. or ft. to 9,999 lb. or ft. | plus 25 % |
| Under 2,000 lb. or ft. | plus 40 % |

### CHARCOAL IRON BOILER TUBES

**Base Discounts, f.o.b. Pittsburgh**

| In. O. D. | |
|---|---|
| 1½ and 1¾ | 44 |
| 2 —2¼ | 12 and 16 |
| 2½—2¾ | 16 and 18 |
| 3 | 17 and 18 |
| 3¼—3½ | 18 and 18 |
| 4 | 20 and 18 |
| 4½, 5, 6 | 21 and 18 |

Extras for quantity: For 1½ to 1¾, up 8 points under 10,000 lb., up 4 points 10,000 lb. to carload. For 2 in. to 3½ in., up 2 points without supplementary 10 per cent, under 10,000 lb.; supplementary 5 per cent instead of supplementary 10 per cent for 10,000 lb. to carload.

In sizes 2 in. to 4½ in. O.D. inclusive, all tubes more than four gages heavier than standard are priced per lb. as follows: Carload and over, 9c.; extras for quantity—under 10,000 lb. 1c. per lb., 10,000 lb. to carload ½c. per lb.

### CAST IRON WATER PIPE

*Per Net Ton*

| | |
|---|---|
| 6-in. and larger, del'd Chicago | $47.00 |
| 4-in., del'd Chicago | 50.00 |
| 6-in. and larger, del'd New York | 43.00 |
| 4-in. del'd New York | 48.00 |
| 6-in., and larger, Birmingham | 39.00 |
| 4-in. Birmingham | 43.00 |

Class "A" and gas pipe, $3 extra

## RAILROAD MATERIALS

### Rails and Track Supplies

**F.o.b. Mill**

| | |
|---|---|
| Standard rails, heavier than 60 lb., per gross ton | $29.37½ |
| Angle bars, per 100 lb. | 2.50 |

**F.o.b. Code Basing Points**

| | |
|---|---|
| Light rails (from billets) per gross ton | $33.00 |
| Light rails (from rail steel) per gross ton | 34.00 |

*Base per 100 Lb.*

| | |
|---|---|
| Spikes, 9/16 in. and larger | $2.60 |
| Spikes, ½ in. and smaller | 2.60 |
| Spikes, boat and barge | 2.60 |
| Tie plates, steel | 1.90 |
| Track bolts, to steam railroads | 3.35 |
| Track bolts, no jobbers, all sizes (per 100 count) | 70 per cent off list |

Basing points on light rails are Pittsburgh, Chicago and Birmingham; on spikes and tie plates, Pittsburgh, Chicago and Birmingham; on spikes and tie plates, Pittsburgh, Chicago, Buffalo, Portsmouth, Ohio, Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., Birmingham and Pacific Coast ports; on tie plates alone, Steelton, Pa.; on spikes alone, Cleveland, Youngstown, Lebanon, Pa., Columbia, Pa., Richmond, Va., Jersey City, N. J.

## BOLTS, NUTS, RIVETS AND SET SCREWS

### Bolts and Nuts

(F.o.b. Pittsburgh, Cleveland, Birmingham or Chicago)

| | *Per Cent Off List* |
|---|---|
| Machine bolts | 70, 10 and 10 |
| Carriage bolts | 70, 10 and 10 |
| Lag bolts | 70, 10 and 10 |
| Plow bolts, Nos. 1, 2, 3 and 7 heads | 70, 10 and 10 |
| Hot-pressed nuts, blank or tapped, square | 70, 10 and 10 |
| Hot-pressed nuts, blank or tapped, hexagons | 70, 10 and 10 |
| C.p.c. and t. square or hex. nuts, blank or tapped | 70, 10 and 10 |
| Semi-finished hexagon nuts U.S.S. all sizes | 70, 10 and 10 |
| Semi-finished hexagon nuts, S.A.E. ¼ in. to 7 1/16 in. diameter | 75 and 10 |
| ⅛ in. to 1 in. diameter | 75 |
| larger than 1 in. diameter | 70 |
| Stove bolts in packages, Pittsburgh | 75 |
| Stove bolts in packages, Chicago | 75 |
| Stove bolts in packages, Cleveland | 75 |
| Stove bolts in bulk, P'gh | 83 |
| Stove bolts in bulk, Chicago | 83 |
| Stove bolts in bulk, Cleveland | 83 |
| Tire bolts | 60 and 10 |

### Large Rivets

(½-in. and larger)

| | *Base per 100 Lb.* |
|---|---|
| F.o.b. Pittsburgh or Cleveland | $2.90 |
| F.o.b. Chicago | 3.00 |
| F.o.b. Birmingham | 3.05 |

### Small Rivets

(7/16-in. and smaller)

| | *Per Cent Off List* |
|---|---|
| F.o.b. Pittsburgh | 70 and 5 |
| F.o.b. Cleveland | 70 and 5 |
| F.o.b. Chicago and Birm'g'm | 70 and 5 |

### Cap and Set Screws

(Freight allowed up to but not exceeding 65c. per 100 lb. on lots of 200 lb. or more)

| | *Per Cent Off List* |
|---|---|
| Milled cap screws, 1 in. dia. and smaller | 75, 10 and 10 |
| Milled standard set screws, case hardened, 1 in. dia. and smaller | 75 and 10 |
| Milled headless set screws, cut thread ¾ in. and smaller | 75 |
| Upset hex. head cap screws, U.S.S.S. or S.A.E. thread, 1 in. dia. and smaller | 85 |
| Upset set screws, cut and oval point | 75 and 10 |
| Milled studs | 65 |

## Alloy and Stainless Steel

### Alloy Steel Ingots

F.o.b. Pittsburgh, Chicago, Canton, Massillon, Buffalo, Bethlehem, Conroe, Texas, Latrobe, Pa., Clairton, Pa., Fairless, Pa., Gary, Ind., Cleveland or Buffalo, Uncropped ..... $40 per gross ton

### Alloy Steel Blooms, Billets and Slabs

F.o.b. Pittsburgh, Chicago, Canton, Massillon, Buffalo, Bethlehem, Conroe, Texas, Latrobe, Pa., Clairton, Pa., Fairless, Pa., Gary, Ind., Cleveland or Buffalo.

Base price, $49 a gross ton.

Price del'd Detroit is $52.

### Alloy Steel Bars

F.o.b. Pittsburgh, Chicago, Buffalo, Bethlehem, Massillon or Canton.

Open-hearth grade, base ..... 2.45c.

Delivered price at Detroit is ..... 2.60c.

| S.A.E. Series Numbers | Alloy Differential per 100 lb. |
|---|---|
| 2000 (1½% Nickel) | $0.25 |
| 2100 (2½% Nickel) | 0.55 |
| 2300 (3½% Nickel) | 1.50 |
| 2500 (5% Nickel) | 2.25 |
| 3100 Nickel Chromium | 0.55 |
| 3200 Nickel Chromium | 1.35 |
| 3300 Nickel Chromium | 3.80 |
| 3400 Nickel Chromium | 3.20 |
| 4100 Chromium Molybdenum (0.15 to 0.25 Molybdenum) | 0.50 |
| 4100 Chromium Molybdenum (0.25 to 0.40 Molybdenum) | 0.70 |
| 4600 Nickel Molybdenum (0.20 to 0.30 Molybdenum) (1.50 to 2.00 Nickel) | 1.05 |
| 5100 Chromium Steel (0.60 to 0.90 Chromium) | 0.35 |
| 5100 Chromium Steel (0.80 to 1.10 Chromium) | 0.45 |
| 5100 Chromium Spring Steel | base |
| 6100 Chromium Vanadium Bar | 1.20 |
| 6100 Chromium Vanadium Spring Steel | 0.95 |
| Chromium Nickel Vanadium | 1.50 |
| Carbon Vanadium | 0.95 |

These prices are for hot-rolled steel bars. The differential for most grades in electric furnace steel is 50c. higher. The differential for cold-drawn bars is ½c. per lb. higher with separate extras. Blooms, billets and slabs under 4x4 in. or equivalent are sold on the bar base. Slabs with a section area of 16 in. and 2½ in. thick or over take the billet base. Sections 4x4 in. to 10x10 in. or equivalent carry a gross ton price, which is the net price for bars for the same analysis: Larger sizes carry extras.

### Alloy Cold-Finished Bars

F.o.b. Pittsburgh, Chicago, Gary, Cleveland or Buffalo, 2.05c. base per lb.

### STAINLESS STEEL No. 302

(17 to 19% Cr, 7 to 9% Ni, 0.08 to 0.20% C)

(Base Prices, f.o.b. Pittsburgh)

| | *Per Lb.* |
|---|---|
| Bars | 23c. |
| Plates | 26c. |
| Sheets | 33c. |
| Hot-rolled strip | 20½c. |
| Cold-rolled strip | 27c. |

# Raw and Semi-Finished Steel

### Carbon Steel Rerolling Ingots

F.o.b. Pittsburgh, Chicago, Gary, Cleveland, Youngstown, Buffalo, Birmingham. Uncropped ..... $29 per gross ton

### Carbon Steel Forging Ingots

F.o.b. Pittsburgh, Chicago, Gary, Cleveland, Youngstown, Birmingham. Uncropped ..... $31 per gross ton

### Billets, Blooms and Slabs

F.o.b. Pittsburgh, Chicago, Gary, Cleveland, Youngstown, Buffalo, Birmingham.

| | *Per Gross Ton* |
|---|---|
| Rerolling | $27.00 |
| Forging quality | 32.00 |
| Delivered Detroit | |
| Rerolling | $30.00 |
| Forging | 35.00 |

Billets Only F.o.b. Duluth

| | |
|---|---|
| Rerolling | $29.00 |
| Forging | 34.00 |

### Sheet Bars

F.o.b. Pittsburgh, Chicago, Cleveland, Youngstown, Buffalo, Canton, Sparrows Point, Md.

| | *Per Gross Ton* |
|---|---|
| Open-hearth or Bessemer | $28.00 |

### Skelp

F.o.b. Pittsburgh, Chicago, Youngstown, Buffalo, Coatesville, Pa., Sparrows Point, Md.

| | *Per Lb.* |
|---|---|
| Grooved | 1.70c. |
| Universal | 1.70c. |
| Sheared | 1.70c. |

### Tube Rounds

| | *Base per Lb.* |
|---|---|
| F.o.b. Pittsburgh | 1.80c. |
| F.o.b. Chicago | 1.85c. |
| F.o.b. Cleveland | 1.85c. |
| F.o.b. Buffalo | 1.90c. |
| F.o.b. Birmingham | 1.95c. |

### Wire Rods

(Common soft, base)

| | *Per Gross Ton* |
|---|---|
| F.o.b. Pittsburgh | $38.00 |
| F.o.b. Cleveland | 38.00 |
| F.o.b. Chicago | 39.00 |
| F.o.b. Anderson, Ind. | 39.00 |
| F.o.b. Youngstown | 39.00 |
| F.o.b. Worcester, Mass. | 40.00 |
| F.o.b. Birmingham | 41.00 |
| F.o.b. San Francisco | 47.00 |

# Pig Iron and Ferroalloys

## PIG IRON

### PRICES PER GROSS TON AT BASING POINTS

| Basing Points | No. 2 Fdry. | Malleable | Basic | Bessemer |
|---|---|---|---|---|
| Everett, Mass. | $19.50 | $20.00 | $19.00 | $20.50 |
| Bethlehem, Pa. | 19.50 | 20.00 | 19.00 | 20.50 |
| Birdsboro, Pa. | 19.50 | 20.00 | 19.00 | 20.50 |
| Swedeland, Pa. | 19.50 | 20.00 | 19.00 | 20.50 |
| Steelton, Pa. | .... | .... | 19.00 | .... |
| Sparrows Point, Md. | 19.50 | .... | 19.00 | .... |
| Neville Island, Pa. | 18.50 | 18.50 | 18.00 | 19.00 |
| Sharpsville, Pa. | 18.50 | 18.50 | 18.00 | 19.00 |
| Youngstown | 18.50 | 18.50 | 18.00 | 19.00 |
| Buffalo | 18.50 | 19.00 | 17.50 | 19.50 |
| Erie, Pa. | 18.50 | 19.00 | 18.00 | 19.50 |
| Cleveland | 18.50 | 18.50 | 18.00 | 19.00 |
| Toledo, Ohio | 18.50 | 18.50 | 18.00 | 19.00 |
| Jackson, Ohio | 20.25 | 20.25 | 19.75 | .... |
| Detroit | 18.50 | 18.50 | 18.00 | 19.00 |
| Hamilton, Ohio | 18.50 | 18.50 | 18.00 | 19.00 |
| Chicago | 18.50 | 18.50 | 18.00 | 19.00 |
| Granite City, Ill. | 18.50 | 18.50 | 18.00 | .... |
| Duluth, Minn. | 19.00 | 19.00 | .... | 19.50 |
| Birmingham | 14.50 | 14.50 | 13.50 | 19.00 |
| Provo, Utah | 17.50 | .... | .... | .... |

### DELIVERED PRICES PER GROSS TON AT CONSUMING CENTERS

| | No. 2 Fdry. | Malleable | Basic | Bessemer |
|---|---|---|---|---|
| Boston Switching District | | | | |
| From Everett, Mass. | $20.00 | $20.50 | $19.50 | $21.00 |
| Brooklyn | | | | |
| From East Pa. or Buffalo | 21.77 | 22.27 | 21.27 | 22.77 |
| Newark or Jersey City, N. J. | | | | |
| From East. Pa. or Buffalo | 20.89 | 21.39 | 20.39 | 21.89 |
| Philadelphia | | | | |
| From Eastern Pa. | 20.26 | 20.76 | 19.76 | 21.26 |
| Cincinnati | | | | |
| From Hamilton, Ohio | 19.51 | 19.51 | 19.01 | 20.01 |
| Canton, Ohio | | | | |
| From Cleveland and Youngstown | 19.76 | 19.76 | 19.26 | 20.26 |
| Columbus, Ohio | | | | |
| From Hamilton, Ohio | 20.50 | 20.50 | .... | .... |
| Mansfield, Ohio | | | | |
| From Cleveland and Toledo | 20.26 | 20.26 | .... | .... |
| Indianapolis | | | | |
| From Hamilton, Ohio | 20.77 | 20.77 | .... | .... |
| South Bend, Ind. | | | | |
| From Chicago | 20.55 | 20.55 | .... | .... |
| Milwaukee | | | | |
| From Chicago | 19.50 | 19.50 | .... | .... |
| St. Paul | | | | |
| From Duluth | 20.94 | .... | .... | .... |
| Davenport, Iowa | | | | |
| From Chicago | 20.26 | 20.26 | .... | .... |
| Kansas City | | | | |
| From Granite City | 21.04 | 21.04 | .... | .... |

Delivered prices on Southern iron for shipment to Northern points are 38c. a gross ton below delivered prices from the nearest Northern basing points.

### LOW PHOSPHORUS PIG IRON

Basing points: Birdsboro, Pa., Steelton, Pa., and Standish, N. Y. ..... $23.50

| | |
|---|---|
| Johnson City, Tenn. | 23.50 |
| Del'd Chicago | 20.15 |
| Johnson City, Tenn. (off grade) | 19.50 |

### GRAY FORGE PIG IRON

| | |
|---|---|
| Valley furnace | $18.25 |

### CHARCOAL PIG IRON

| | |
|---|---|
| Lake Superior furnace | $21.00 |
| Delivered Chicago | 24.04 |
| Delivered Buffalo | 24.28 |

### CANADA

#### Pig Iron

Per gross ton:

Delivered Toronto

| | |
|---|---|
| No. 1 fdy., sil. 2.25 to 2.75 | $21.00 |
| No. 2 fdy., sil. 1.75 to 2.25 | 20.50 |
| Malleable | 21.00 |

Delivered Montreal

| | |
|---|---|
| No. 1 fdy., sil. 2.25 to 2.75 | $22.50 |
| No. 2 fdy., sil. 1.75 to 2.25 | 22.00 |
| Malleable | 22.50 |
| Basic | 22.00 |

## FERROALLOYS

### Ferromanganese

F.o.b. New York, Philadelphia, Baltimore, Mobile or New Orleans.

| | *Per Gross Ton* |
|---|---|
| Domestic, 80% (carload) | $85.00 |

### Spiegeleisen

| | *Per Gross Ton Furnace* |
|---|---|
| Domestic, 19 to 21% | $28.00 |

### Electric Ferrosilicon

| | *Per Gross Ton Delivered* |
|---|---|
| 50% (carloads) | $77.50 |
| 50% (ton lots) | 85.00 |
| 75% (carloads) | 120.00 |
| 75% (ton lots) | 130.00 |
| 14% to 16% (f.o.b.) Welland, Ont. (in carloads) (duty paid) | 31.00 |
| 14% to 16% (less carloads) | 38.50 |

### Silvery Iron

F.o.b. Jackson, Ohio, Furnace

| *Per Gross Ton* | | *Per Gross Ton* | |
|---|---|---|---|
| 6% | $22.75 | 12% | $29.25 |
| 7% | 23.75 | 13% | 30.75 |
| 8% | 24.75 | 14% | 32.25 |
| 9% | 25.75 | 15% | 33.75 |
| 10% | 26.75 | 16% | 35.25 |
| 11% | 27.75 | 17% | 36.75 |

The lower all-rail delivered price from Jackson or Buffalo is quoted with freight allowed.

### Bessemer Ferrosilicon

F.o.b. Jackson, Ohio, Furnace

| *Per Gross Ton* | | *Per Gross Ton* | |
|---|---|---|---|
| 10% | $27.75 | 14% | $33.25 |
| 11% | 28.75 | 15% | 34.75 |
| 12% | 30.25 | 16% | 36.25 |
| 13% | 31.75 | 17% | 37.75 |

Manganese 1½ to 3%, $1 a ton additional. For each unit of manganese over 3%, $1 a ton additional. Phosphorus 0.75% or over, $1 ton additional.

Base prices at Buffalo are $1.25 a ton higher than at Jackson.

### Other Ferroalloys

| | |
|---|---|
| Ferrotungsten, per lb. contained W. del., carloads | $1.35 to $1.45 |
| Ferrotungsten, less carloads | 1.45 to 1.55 |
| Ferrochromium, 4 to 6% carbon and up, 65 to 70% Cr. per lb. contained Cr. delivered, in carloads | 20.00c. |
| Ferrochromium, 2% carbon | 16.50c. to 17.00c. |
| Ferrochromium, 1% carbon | 17.50c. to 18.00c. |
| Ferrochromium, 0.10% carbon | 19.50c. to 20.00c. |
| Ferrochromium, 0.06% carbon | 20.00c. to 20.50c. |
| Ferrovanadium, del., per lb. contained V | $2.70 to $2.90 |
| Ferrocarbontitanium, 15 to 18% Ti, 6 to 8% C, f.o.b. furnace carload and contract per net ton | $137.50 |
| Ferrophosphorus, electric, or blast furnace material, in carloads, 18%, Rockdale, Tenn., base, per gross ton with $2 unitage | 50.00 |
| Ferrophosphorus, electric, 24% f.o.b. Anniston, Ala., per gross ton with $2.75 unitage | 65.00 |
| Ferromolybdenum, per lb. Mo., del. | 95c. |
| Calcium molybdate, per lb. Mo., del. | 80c. |
| Silico spiegel, per ton, f.o.b. furnace, car lots | $38.00 |
| Ton lots or less, per ton | 45.50 |
| Silico-manganese, gross ton, delivered: | |
| 2.50% carbon grade | 90.00 |
| 2% carbon grade | 95.00 |
| 1% carbon grade | 105.00 |
| Spot prices | $5 a ton higher |

# Iron and Steel Scrap

## PITTSBURGH

**Per gross ton delivered consumers' yards:**

| | |
|---|---|
| No. 1 heavy melting steel | $10.00 to $10.50 |
| No. 2 heavy melting steel | 9.00 to 9.50 |
| No. 3 railroad wrought | 10.00 to 10.50 |
| Scrap rails | 10.00 to 10.50 |
| Rails 3 ft. and under | 13.50 to 14.00 |
| Compressed sheet steel | 10.00 to 10.50 |
| Hand bundled sheet steel | 9.00 to 9.50 |
| Hvy. steel axle turnings | 9.00 to 9.50 |
| Machine shop turnings | 6.75 to 7.25 |
| Short shov. turnings | 6.75 to 7.25 |
| Short mixed borings and turnings | 5.25 to 5.75 |
| Cast iron borings | 5.25 to 5.75 |
| Cast iron carwheels | 11.00 to 11.50 |
| Heavy breakable cast | 10.00 to 10.50 |
| No. 1 cast | 11.00 to 11.50 |
| Railr. knuckles and couplers | 12.00 to 13.50 |
| Rail. coil and leaf springs | 13.00 to 13.50 |
| Rolled steel wheels | 13.00 to 13.50 |
| Low phos. billet crops | 13.00 to 13.50 |
| Low phos. sheet bar crops | 12.00 to 12.50 |
| Low phos. plate scrap | 12.00 to 12.50 |
| Low phos. punchings | 12.50 to 13.00 |
| Steel car axles | 13.00 to 13.50 |

## CHICAGO

**Delivered Chicago district consumers:**

*Per Gross Ton*

| | |
|---|---|
| Heavy melting steel | $8.50 to $9.00 |
| Automobile hvy. melt. steel | 8.00 to 8.50 |
| Shoveling steel | 8.50 to 9.00 |
| Hydraulic comp. sheets | 7.75 to 8.25 |
| Drop forge flashings | 6.50 to 7.00 |
| No 1 busheling | 7.50 to 8.00 |
| Rolled carwheels | 10.00 to 10.50 |
| Railroad tires | 10.00 to 10.50 |
| Railroad leaf springs | 10.00 to 10.50 |
| Axle turnings | 8.00 to 8.50 |
| Steel couplers and knuckles | 10.00 to 10.50 |
| Coil springs | 10.50 to 11.00 |
| Axle turnings (elec. fur.) | 8.00 to 8.50 |
| Low phos. punchings | 10.00 to 10.50 |
| Low phos. plates, 12 in. and under | 10.00 to 10.50 |
| Cast iron borings | 4.50 to 5.00 |
| Short shoveling turnings | 4.50 to 5.00 |
| Machine shop turnings | 4.25 to 4.75 |
| Rerolling rails | 10.00 to 10.50 |
| Steel rails, less than 3 ft. | 10.75 to 11.25 |
| Steel rails, less than 2 ft. | 11.25 to 11.75 |
| Angle bars, steel | 9.50 to 10.00 |
| Cast iron carwheels | 9.50 to 10.00 |
| Railroad malleable | 9.00 to 9.50 |
| Agricultural malleable | 7.75 to 8.25 |

*Per Net Ton*

| | |
|---|---|
| Iron car axles | $12.00 to $12.50 |
| Steel car axles | 10.00 to 10.50 |
| No. 1 railroad wrought | 7.00 to 7.50 |
| No. 2 railroad wrought | 7.50 to 8.00 |
| No. 2 busheling | 3.50 to 4.00 |
| Locomotive tires, smooth | 9.00 to 9.50 |
| Pipe and flues | 4.50 to 5.00 |
| No. 1 machinery cast | 8.00 to 8.50 |
| Clean automobile cast | 8.00 to 8.50 |
| No. 1 railroad cast | 7.50 to 8.00 |
| No. 1 agricultural cast | 7.00 to 7.50 |
| Stove plate | 5.25 to 5.75 |
| Grate bars | 4.75 to 5.25 |
| Brake shoes | 6.00 to 6.50 |

## PHILADELPHIA

**Per gross ton delivered consumers' yards:**

| | |
|---|---|
| No. 1 heavy melting steel | $9.25 to $9.75 |
| No. 2 heavy melting steel | $8.00 to 8.50 |
| No. 1 railroad wrought | $11.00 to 11.50 |
| Bundled sheets | 9.00 |
| Hydraulic compressed, new | 9.00 to 9.50 |
| Hydraulic compressed, old | 6.50 to 7.00 |
| Machine shop turnings | 5.50 to 6.00 |
| Heavy axle turnings | 8.50 to 9.00 |
| Cast borings | 5.00 to 5.50 |
| Heavy breakable cast | 9.50 to 10.00 |
| Stove plate (steel works) | 8.00 |
| No. 1 low phos. heavy | 13.00 to 14.00 |
| Couplers and knuckles | 12.50 to 13.00 |
| Rolled steel wheels | 12.50 to 13.00 |
| No 1 blast furnace | 5.00 to 5.50 |
| Shee. iron and steel pipe | 8.00 |
| Shafting | 15.00 to 16.00 |
| Steel axles | 14.50 |
| No. 1 forge fire | 9.00 |
| Cast iron car wheels | 11.00 to 11.50 |
| No. 1 cast | 11.50 to 12.00 |
| Cast borings (chem.) | 13.00 to 14.00 |
| Steel rails for rolling | 12.00 |

## CINCINNATI

**Dealers' buying prices per gross ton:**

| | |
|---|---|
| Heavy melting steel | $6.75 to $7.25 |
| Scrap rails for melting | 8.00 to 8.50 |
| Loose sheet clippings | 3.00 to 3.50 |
| Bundled sheets | 5.50 to 6.00 |
| Cast iron borings | 4.50 to 5.00 |
| Machine shop turnings | 4.00 to 4.50 |
| No. 1 busheling | 5.50 to 6.00 |
| No. 2 busheling | 2.50 to 3.00 |
| Rails for rolling | 8.50 to 9.00 |
| No. 1 locomotive tires | 8.25 to 8.75 |
| Short rails | 11.00 to 11.50 |
| Cast iron carwheels | 7.50 to 8.00 |
| No. 1 machinery cast | 8.75 to 9.25 |
| No. 1 railroad cast | 8.25 to 8.75 |
| Burnt cast | 5.75 to 6.25 |
| Stove plate | 5.75 to 6.25 |
| Agricultural malleable | 7.75 to 8.25 |
| Railroad malleable | 7.75 to 8.25 |

## CLEVELAND

**Per gross ton delivered consumers' yards:**

| | |
|---|---|
| No. 1 heavy melting steel | $8.00 to $8.50 |
| No. 2 heavy melting steel | 7.50 to 8.00 |
| Compressed sheet steel | 7.25 to 7.75 |
| Light bundled sheet stampings | 6.50 to 7.00 |
| Drop forge flashings | 7.00 to 7.50 |
| Machine shop turnings | 6.00 to 6.50 |
| Short shoveling turnings | 6.50 to 7.00 |
| No. 1 busheling | 7.00 to 7.50 |
| Steel axle turnings | 7.00 to 7.50 |
| Low phos. billet crops | 12.50 to 13.00 |
| Cast iron borings | 6.25 to 6.75 |
| Mixed borings and short turnings | 6.25 to 6.75 |
| No. 2 busheling | 6.25 to 6.75 |
| No. 1 cast | 10.50 to 11.00 |
| Railroad grate bars | 7.00 to 7.50 |
| Stove plate | 6.50 to 7.00 |
| Rails under 3 ft. | 12.50 to 13.00 |
| Rails for rolling | 15.50 to 18.00 |
| Railroad malleable | 11.50 to 12.00 |
| Cast iron carwheels | 9.75 to 10.00 |

## BUFFALO

**Per gross ton, f.o.b. Buffalo consumers' plants:**

| | |
|---|---|
| No. 1 heavy melting steel | $10.00 to $10.50 |
| No. 2 heavy melting scrap | 8.50 to 9.00 |
| Scrap rails | 9.50 to 10.00 |
| New hydraul. comp. sheets | 8.50 to 9.00 |
| Old hydraul. comp. sheets | 7.50 to 8.00 |
| Drop forge flashings | 8.50 to 9.00 |
| No. 1 busheling | 8.50 to 9.00 |
| Hvy. steel axle turnings | 6.50 to 7.00 |
| Machine shop turnings | 5.00 to 5.50 |
| Knuckles and couplers | 11.00 to 11.50 |
| Coil and leaf springs | 11.00 to 11.50 |
| Rolled steel wheels | 11.00 to 11.50 |
| Low phos. billet crops | 11.50 to 12.00 |
| Short shov. steel turnings | 5.50 to 6.00 |
| Short mixed borings and turnings | 5.50 to 6.00 |
| Cast iron borings | 5.50 to 6.00 |
| No. 2 busheling | 5.00 to 5.50 |
| Steel car axles | 10.50 to 11.00 |
| Iron axles | 10.50 to 11.00 |
| No. 1 machinery cast | 10.50 to 11.00 |
| No. 1 cupola cast | 9.00 to 9.50 |
| Stove plate | 8.50 to 8.75 |
| Steel rails, 3 ft. and under | 12.00 to 12.50 |
| Cast iron carwheels | 10.00 to 10.50 |
| Industrial malleable | 10.50 to 11.00 |
| Railroad malleable | 10.50 to 11.00 |
| Chemical borings | 7.00 to 7.50 |

## BOSTON

**Dealers' buying prices per gross ton:**

| | |
|---|---|
| No. 1 heavy melting steel | $5.50 to $6.00 |
| Scrap T rails | 5.50 to 6.00 |
| No. 2 steel | 5.00 to 5.25 |
| Breakable cast | 6.00 to 6.50 |
| Machine shop turnings | 1.25 to 1.50 |
| Bundled skeleton, long | 3.30 to 3.50 |
| Forge flashings | 4.25 to 4.50 |
| Blast furnace scrap | 2.00 to 2.50 |
| Shafting | 11.00 to 11.25 |
| Steel car axles | 10.50 to 11.00 |
| Cast iron borings, chemical | 6.00 to 7.00 |
| Stove plate | .... to 6.50 |

**Per gross ton delivered consumers' yards:**

| | |
|---|---|
| Textile cast | $7.50 to $9.00 |
| No. 1 machinery cast | 7.50 to 9.00 |
| Railroad malleable | 11.00 to 11.50 |

## NEW YORK

**Dealers' buying prices per gross ton:**

| | |
|---|---|
| No. 1 heavy melting steel | *$7.00 ††$8.00 |
| No. 2 heavy melting steel | *5.50 to ††6.50 |
| Heavy breakable cast | 6.00 to 6.50 |
| No. 1 machinery cast | 7.00 to 7.50 |
| No. 2 cast | 6.25 to 6.75 |
| Stove plate | 5.00 to 5.50 |
| Steel car axles | 11.50 to 12.00 |
| No. 1 railroad wrought | 7.50 to 8.00 |
| No. 1 yard wrought, long | 6.50 to 7.00 |
| Shee. iron and steel pipe | 4.50 to 5.00 |
| Forge fire | 5.50 to 6.00 |
| Rails for rerolling | 7.50 to 8.50 |
| Short shoveling turnings | 3.50 to 3.00 |
| Machine shop turnings | 2.50 to 3.00 |
| Cast borings | 3.50 to 3.75 |
| No. 1 blast furnace | 2.00 to 2.50 |
| Cast borings (chemical) | 11.00 to 11.50 |
| Unprepared yard iron and steel | 3.00 to 4.00 |

**Per gross ton, delivered local foundries:**

| | |
|---|---|
| No. 1 machinery cast | $10.25 |
| No. 1 hvy. cast (cupola size) | 9.00 |
| No. 2 cast | 8.00 |

*For direct car loading only.
†Loading on barge.

## BIRMINGHAM

**Per gross ton delivered consumers' yards:**

| | |
|---|---|
| Heavy melting steel | .... $8.50 |
| Scrap steel rails | .... 9.00 |
| Short shoveling turnings | .... 5.50 |
| Stove plates | .... 6.50 |
| Steel axles | $10.50 to 11.00 |
| Iron axles | 10.50 to 11.00 |
| No. 1 railroad wrought | .... 5.50 |
| Rails for rollings | .... 10.50 |
| No. 1 cast | 9.50 to 10.00 |
| Tramcar wheels | 9.00 to 9.50 |
| Cast iron borings, chem. | .... 8.00 |

## ST. LOUIS

**Per gross ton delivered consumers' yards:**

| | |
|---|---|
| Selected heavy steel | $8.75 to $9.25 |
| No. 1 heavy melting | 7.00 to 7.50 |
| No. 2 heavy melting | 6.50 to 7.00 |
| No. 1 locomotive tires | 9.50 to 10.00 |
| Misc. stand-sec. rails | 8.75 to 9.25 |
| Railroad springs | 9.00 to 9.50 |
| Bundled sheets | 6.00 to 6.50 |
| No. 2 railroad wrought | 8.00 to 8.50 |
| No. 1 busheling | 5.00 to 5.50 |
| Cast iron borings and shoveling turnings | 2.50 to 3.00 |
| Rails for rolling | 9.75 to 10.25 |
| Machine shop turnings | 2.50 to 3.00 |
| Heavy turnings | 5.50 to 6.00 |
| Steel car axles | 10.50 to 11.00 |
| Iron car axles | 12.50 to 13.00 |
| No. 1 railroad wrought | 5.50 to 6.00 |
| Steel rails less than 3 ft. | 10.75 to 11.25 |
| Steel angle bars | 9.00 to 9.50 |
| Cast iron carwheels | 7.50 to 8.00 |
| No. 1 machinery cast | 8.50 to 9.00 |
| Railroad malleable | 8.50 to 9.00 |
| No. 1 railroad cast | 8.50 to 9.00 |
| Stove plate | 6.50 to 7.00 |
| Agricult. malleable | 8.50 to 9.00 |

## DETROIT

**Dealers' buying prices per gross ton:**

| | |
|---|---|
| Heavy melting steel | $6.75 to $7.25 |
| Borings and short turnings | 4.75 to 5.25 |
| Long turnings | $3.75 to $4.25 |
| No. 1 machinery cast | 9.00 to 9.50 |
| Automotive cast | 9.75 to 10.25 |
| Hydraul. comp. sheets | 6.75 to 7.25 |
| Stove plate | 6.25 to 6.75 |
| New factory busheling | 5.75 to 6.25 |
| Old No. 2 busheling | 4.00 to 4.50 |
| Sheet clippings | 3.00 to 3.50 |
| Flashings | 5.50 to 6.00 |
| Low phos. plate scrap | 7.00 to 7.50 |

## CANADA

**Dealers' buying prices per gross ton:**

| | Toronto | Montreal |
|---|---|---|
| Heavy melting steel | $5.50 | $5.50 |
| Rails scrap | 6.00 | 4.50 |
| Machine shop turnings | 2.50 | 2.50 |
| Boiler plate | 4.50 | 4.50 |
| Heavy axle turnings | 2.50 | 2.00 |
| Cast borings | 3.00 | 3.00 |
| Steel borings | 2.00 | 2.00 |
| Wrought pipe | 2.50 | 2.50 |
| Steel axles | 4.50 | 6.00 |
| Axles wrought iron | 4.50 | 6.50 |
| No. 1 machinery cast | 7.75 | 9.00 |
| Stove plate | 4.50 | 5.00 |
| Standard carwheels | 7.25 | 7.00 |
| Malleable | 6.75 | 7.00 |

# ORES, FLUORSPAR, COKE, FUEL, REFRACTORIES

### Lake Superior Ores

*Delivered Lower Lake Ports*

*Per Gross Ton*

| | |
|---|---|
| Old range, Bessemer, 51.5% iron | $4.80 |
| Old range, non-Bessemer, 51.50% iron | 4.65 |
| Mesabi, Bessemer, 51.50% iron | 4.65 |
| Mesabi, non-Bessemer, 51.50% iron | 4.50 |
| High phosphorus, 51.50% iron | 4.40 |

### Foreign Ore

*C.A.f. Philadelphia or Baltimore*

*Per Unit*

| | |
|---|---|
| Iron, low phos., copper free, 55 to 58% iron, dry Spanish or Algeria | 9.50c. |
| Iron, low phos., Swedish, average 68½% iron | 9.50c. |
| Iron, basic or foundry, Swedish, aver. 65% iron | 9c. |
| Iron, basic or foundry, Russian, aver. 65% iron | 9c. |
| Manganese, Caucasian, washed 52% | 26c. |
| Manganese, African, Indian, 44-48% | 21c. |
| Manganese, African, Indian, 49-51% | 24c. |
| Manganese, Brazilian, 46 to 48½ | 20c. |

*Per Net Ton Unit*

| | |
|---|---|
| Tungsten, Chinese, wolframite, duty paid, delivered* | $17.50 to $18.50 |
| Tungsten, domestic scheelite, delivered† | 17.00 |

*Per Gross Ton*

| | |
|---|---|
| Chrome, 45%, $Cr_2O_3$, crude, c.i.f. Atlantic Seaboard | $17.00 |
| Chrome, 48%, $Cr_2O_3$, c.i.f. Atlantic Seaboard | 20.00 |

*Quotations nominal in absence of sales.
†Nominal; no supplies available.

### Fluorspar

*Per Net Ton*

| | |
|---|---|
| Domestic, washed gravel, 85-5 f.o.b. Kentucky and Illinois mines for all-rail shipment | $15.50 to $16.00 |
| Same grade for Ohio River barge shipment for Kentucky and Illinois River landings | 17.50 |
| No. 2 lump, 85-5, f.o.b. Kentucky and Illinois mines | $15.50 to 16.00 |
| Foreign, 85% calcium fluoride, not over 5% sil'con, c.i.f. Atlantic port, duty paid | 19.00 |
| Domestic, No. 1 ground bulk, 95 to 98% calcium fluoride, not over 2½% silicon, f.o.b. Illinois and Kentucky mines | $9.00 |

## COKE, COAL AND FUEL OIL

### Coke

*Per Net Ton*

| | |
|---|---|
| Furnace, f.o.b. Connellsville Prompt | $3.85 |
| Foundry, f.o.b. Connellsville Prompt | $4.60 to 5.10 |
| Foundry, by-product, Chicago ovens, for delivery outside switching district | 8.50 |
| Foundry, by-product, delivered in Chicago switching district | 9.25 |
| Foundry, by-product, New England, delivered | 11.00 |
| Foundry, by-product, Newark or Jersey City, del'd | 8.20 to 8.81 |
| Foundry, by-product, Phila. | 9.00 |
| Foundry, by-product, Cleveland, delivered | 9.25 |
| Foundry, Birmingham | 6.00 |
| Foundry, by-product, St. Louis, f.o.b. ovens | 8.00 |
| Foundry, by-product, del'd St. Louis | 9.00 |

### Coal

*Per Net Ton*

| | |
|---|---|
| Mine run steam coal, f.o.b. W. Pa. mines | $1.80 to $2.05 |
| Mine run coking coal f.o.b. W. Pa. | 2.05 to 2.25 |
| Gas coal, ¾-in. f.o.b. Pa. m'nes | 2.25 to 2.50 |
| Mine run gas coal f.o.b. Pa. mines | 2.05 to 2.40 |
| Steam slack, f.o.b. W. Pa. mines | 1.55 to 1.65 |
| Gas slack, f.o.b. W. Pa. mines | 1.90 to 2.10 |

### Fuel Oil

*Per Gal. f.o.b. Bayonne, N. J.*

| | |
|---|---|
| No. 3 distillate | 4.00c. |
| No. 4 industrial | 3.50c. |

*Per Gal. f.o.b. Baltimore*

| | |
|---|---|
| No. 3 distillate | 4.00c. |
| No. 4 industrial | 3.50c. |

*Per Gal. del'd Chicago*

| | |
|---|---|
| No. 3 industrial fuel oil | 3.40c. |
| No. 5 industrial fuel oil | 3.30c. |

*Per Gal. f.o.b. Cleveland*

| | |
|---|---|
| No. 3 distillate | 5.00c. |
| No. 4 industrial | 4.25c. |
| No. 5 industrial | 4.00c. |

## REFRACTORIES

### Fire Clay Brick

| | *Per 1000 f.o.b. Works* High-heat Duty Brick | Intermediate Duty Brick |
|---|---|---|
| Pennsylvania | $45.00 | $40.00 |
| Maryland | 45.00 | 40.00 |
| New Jersey | 55.00 | 45.00 |
| Ohio | 45.00 | 40.00 |
| Kentucky | 45.00 | 40.00 |
| Missouri | 45.00 | 40.00 |
| Illinois | 45.00 | 40.00 |
| Ground fire clay, per ton | 7.00 | |

### Chrome Brick

*Per Net Ton*

| | |
|---|---|
| Standard size | $45.00 |

### Silica Brick

*Per 1000 f.o.b. Works*

| | |
|---|---|
| Pennsylvania | $45.00 |
| Chicago | 50.00 |
| Birmingham | 55.00 |
| Silica clay, per ton | 8.00 |

### Magnesite Brick

*Per Net Ton*

| | |
|---|---|
| Standard size, burned, f.o.b. Baltimore and Chester, Pa. | $65.00 |
| *Unburned*, f.o.b. Baltimore | 55.00 |
| Imported grain magnesite, f.o.b. Baltimore and Chester, Pa. | 45.00 |
| Domestic grain magnesite, f.o.b. Baltimore and Chester, Pa. | 40.00 |
| Domestic, f.o.b. Chewelah, Wash. | 32.00 |

# Warehouse Prices for Steel Products

## PITTSBURGH

| | Base per Lb. |
|---|---|
| Plates | 3.15c. |
| Structural shapes | 3.15c. |
| Soft steel bars and small shapes | 2.90c. |
| Reinforcing steel bars | 2.90c. |
| Cold-finished and screw stock— | |
| Rounds and hexagons | *3.45c. |
| Squares and flats | *3.45c. |
| Hoops and bands under ¼ in. | 3.20c. |
| Hot-rolled annealed sheets (No. 24), 25 or more bundles | 3.30c. |
| Galv. sheets (No. 24), 25 or more bundles | 3.95c. |
| Hot-rolled sheets (No. 10) | 2.95c. |
| Galv. corrug. sheets (No. 28), per square (more than 3750 lb.) | $3.69 |
| Spikes, large | 2.90c. |
| Track bolts, all sizes, per 100 count, 65 per cent off list. | |
| Machine bolts, 100 count, 65 per cent off list. | |
| Carriage bolts, 100 counts, 65 per cent off list. | |
| Nuts, all styles, 100 count, 65 per cent off list. | |
| Large rivets, base per 100 lb. | $3.50 |
| Wire, black, soft ann'l'd, base per 100 lb. | *2.70c. |
| Wire, galv. soft, base per 100 lb. | *2.925c. |
| Common wire nails, per keg | *2.834c. |
| Cement coated nails, per keg | *2.834c. |

On plates, structurals, bars, reinforcing bars, bands, hoops and blue annealed sheets, base applied to orders of 400 to 9999 lb.

*Delivered in Pittsburgh switching district.

## CHICAGO

| | Base per Lb. |
|---|---|
| Plates and structural shapes | 3.20c. |
| Soft steel bars | 2.95c. |
| Cold-fin. steel bars and shafting: | |
| Rounds and hexagons | 3.50c. |
| Flats and squares | 3.50c. |
| Hot-rolled strip | 3.30c. |
| Hot-rolled annealed sheets (No. 24) | 3.85c. |
| Galv. sheets (No. 24) | 4.55c. |
| Hot-rolled sheets (No. 10) | 3.05c. |
| Spikes (9/16 in. and lighter) | 3.50c. |
| Track bolts | 4.65c. |
| Rivets, structural (keg lots) | 3.50c. |
| Rivets, boiler (keg lots) | 3.60c. |

| | Per Cent Off List |
|---|---|
| Machine bolts | 60 and 5 |
| Carriage bolts | 60 and 5 |
| Coach and lag screws | 60 and 5 |
| Hot-pressed nuts, sq. tap. or blank | 60 and 5 |
| Hot-pressed nuts, hex. tap or blank | 60 and 5 |
| Hex. head and cap screws | 60 |
| Cup point set screws | 70 and 10 |
| Flat head bright wood screws | 87½ and 10 |
| Spring cotters | 50 |
| Stove bolts in full packages | 70 and 10 |
| Rd. hd. tank rivets, 7/16 in. and smaller | 57½ |
| Wrought washers | $4.50 off list |
| No. 8 black ann'l'd wire per 100 lb. | $3.85 |
| Com. wire nails, base per keg | 3.05c. |
| Cement c't'd nails, base per keg | 3.95c. |

## NEW YORK

| | Base per Lb. |
|---|---|
| Plates, ¼ in. and heavier | 3.40c. |
| Structural shapes | 3.37c. |
| Soft steel bars, small shapes | 3.22c. |
| Iron bars | 3.22c. |
| Iron bars, swed. charcoal | 6.50c. to 7.25c |
| Cold-fin. shafting and screw stock; | |
| Rounds and hexagons | 3.92c. |
| Flats and squares | 4.42c. |
| Cold-roll. strip, soft and quarter hard | 3.32c. |
| Hoops | 3.52c. |
| Bands | 3.52c. |
| Hot-rolled sheets (No. 10) | 3.27c. |
| Hot-rolled ann'l'd sheets (No. 24*) | 3.85c. |
| Galvanized sheets (No. 24*) | 4.50c. |
| Long terne sheets (No. 24) | 5.20c. |
| Standard tool steel | 11.00c. |
| Wire, black annealed (No. 10) | 3.25c. |
| Wire, galv. (No. 10) | 3.85c. |
| Tire steel, 1 x ½ in. and larger | 3.6?c. |
| Open hearth spring steel | 4.00c. to 10.00c. |
| Common wire nails, base, per keg | $3.21 |

| | Per Cent Off List |
|---|---|
| Machine bolts, cut thread: All diameters | 70 |
| Carriage bolts, cut thread: All diameters | 70 |

| Boiler tubes: | Per 100 Ft. |
|---|---|
| Lap welded, 2-in. | $18.05 |
| Seamless welded, 2-in. | 19.24 |
| Charcoal iron, 2-in. | 24.94 |
| Charcoal iron, 4-in. | 63.65 |

*No. 28 and lighter, 36 in. wide, 20c. higher per 100 lb.

## ST. LOUIS

| | Base per Lb. |
|---|---|
| Plates and struc. shapes | 3.44c. |
| Bars, soft steel or iron | 3.19c. |
| Cold-fin. rounds, shafting, screw stock | 3.74c. |
| Hot-rolled annealed sheets (No. 24) | 4.09c. |
| Galv. sheets (No. 24) | 4.79c. |
| Hot-rolled sheets (No. 10) | 3.29c. |
| Black corrug. sheets (No. 24) | 4.09c. |
| *Galv. corrug. sheets | 4.79c. |
| Structural rivets | 3.99c. |
| Boiler rivets | 4.09c. |

| | Per Cent Off List |
|---|---|
| Tank rivets, 7/16 in. and smaller | 55 |
| Machine and carriage bolts, lag screws, fittings up bolts, bolt ends, plow bolts, hot-pressed nuts, square and hexagon, tapped or blank, semi-finished nuts: | |
| 1000 lb. or over | 60 and 5 |
| 200 to 999 lb. | 60 |
| 100 to 199 lb. | 55 |
| Less than 100 lb. | 50 |

*No. 26 and lighter take special prices.

## PHILADELPHIA

| | Base per Lb. |
|---|---|
| *Plates, ¼-in. and heavier | 2.95c. |
| *Structural shapes | 2.95c. |
| *Soft steel bars, small shapes, iron bars (except bands) | 2.90c. |
| ‡Reinforc. steel bars, sq. twisted and deformed | 2.955c. |
| Cold-finished steel bars | 3.40c. |
| *Steel hoops | 3.40c. |
| *Steel bands, No. 12 and 3/16 in., incl. | 3.15c. |
| Spring steel | 5.00c. |
| †Hot-rolled anneal. sheets (No. 24) | 3.55c. |
| †Galvanized sheets (No. 24) | 4.25c. |
| *Hot-rolled annealed sheets (No. 10) | 3.05c. |
| Diam. pat. floor plates, ¼ in. | 4.90c. |
| Swedish iron bars | 6.25c. |

These prices are subject to quantity differentials except on reinforcing and Swedish iron bars.

*Base prices subject to deduction on orders aggregating 4000 lb. or over.

†For 50 bundles or over.

‡For less than 2000 lb.

## CLEVELAND

| | Base per Lb. |
|---|---|
| Plates and struc. shapes | 3.31c. |
| Soft steel bars | 2.95c. |
| Reinforc. steel bars | *2.10c. |
| Cold-finished steel bars | 3.40c. |
| Flat-rolled steel under ¼ in. | 3.36c. |
| Cold-finished strip | †3.00c. |
| Hot-rolled annealed sheets (No. 24) | 3.96c. |
| Galvanized sheets (No. 24) | 4.61c. |
| Hot rolled sheets (No. 10) | 3.11c. |
| Hot-rolled 3/16 in. 24 to 48 in. wide sheets | 3.56c. |
| Black ann'l'd wire, per 100 lb. | $2.65 |
| No. 9 galv. wire, per 100 lb. | 3.00 |
| Com. wire nails, base per keg | 2.40 |

*Plus mill, size and quantity extras.
†Outside delivery 10c. less.

## CINCINNATI

| | Base per Lb. |
|---|---|
| Plates and struc. shapes | 3.40c. |
| Bars, soft steel or iron | 3.15c. |
| New billet reinforc. bars | 3.25c. |
| Rail steel reinforc. bars | 3.25c. |
| Hoops and bands, 3/16 in. and lighter | 3.45c. |
| Cold finished bars | 3.70c. |
| Hot-rolled annealed sheets (No. 24) | 4.00c. |
| Galv. sheets (No. 24) | 4.70c. |
| Hot-rolled sheets (No. 10) | 3.20c. |
| Structural rivets | 4.35c. |
| Small rivets | 55 per cent off list |
| No. 9 ann'l'd wire, per 100 lb. (1000 lb. or over) | $2.91 |
| Com. wire nails, base per keg (1 to 24 kegs) | 3.50 |
| 25 to 50 kegs | 3.30 |
| Larger quantities | 3.10 |
| Cement c't'd nails, base 100-lb. keg | 3.50 |
| Chain, 1-in., per 100 lb. | 8.35 |
| Seamless steel boiler tubes, 2-in. | Net per 100 ft. $19.03 |
| 4-in. | 44.96 |
| Lap-welded steel boiler tubes, 2-in. | 19.10 |
| 4-in. | 42.32 |

## BUFFALO

| | Base per Lb. |
|---|---|
| Plates | 3.37c. |
| Struc. shapes | 3.37c. |
| Soft steel bars | 3.00c. |
| Reinforcing bars | 2.60c. |
| Cold-fin. flats and sq. | 3.55c. |
| Round and hex. | 3.50c. |
| Cold-rolled strip steel | 3.30c. |
| Hot-rolled annealed sheets (No. 24) | 4.05c. |
| Heavy hot-rolled sheets, 3/16 in., 24 to 48 in. wide | 3.62c. |
| Galv. sheets (No. 24) | 4.65c. |
| Bands | 3.42c. |
| Hoops | 3.42c. |
| Hot-rolled unannealed sheets | 3.17c. |
| Com. wire nails, base per keg | $3.35 |
| Black wire, base per 100 lb. | 3.45c. |

## BOSTON

| | Per Lb. |
|---|---|
| Beams, channels, angles, tees, sees | 3.52c. |
| H beams and shapes | 3.52c.* |
| Plates—sheared, tank and univ. mill, ¼ in. thick and heavier | 3.52c.* |
| Floor plates, diamond pattern | 5.33c. |
| Bar and bar shapes (mild steel) | 3.30c. |
| Bands 3/16 in. thick and No. 12 ga. incl. | 3.60c. to 4.00c. |
| Half rounds, half ovals, ovals and bevels | 4.55c. |
| Tire steel | 4.55c. |
| Cold-finished rounds and hexagons | 5.25c.* |
| Cold-rolled strip steel | 3.25c. |
| Cold-finished squares and flats | 5.75c. |
| Blue annealed sheets, No. 10 gal. | 3.60c. |
| One pass cold-rolled sheets No. 24 ga. | 4.15c. |
| Galvanized steel sheets, No. 24 ga. | 4.85c. |
| Lead coated sheets, No. 24 ga. | 5.80c. |

Prices delivered by truck in metropolitan Boston, subject to quantity differentials.
*Base.

## PACIFIC COAST

| | Base per Lb. San Francisco | Los Angeles | Seattle |
|---|---|---|---|
| Plates, tank and U. M. | 3.55c. | 3.70c. | 3.55c. |
| Shapes, standard | 3.55c. | 3.70c. | 3.55c. |
| Soft steel bars | 3.60c. | 3.70c. | 3.55c. |
| Reinforcing bars | 3.50c. | 3.50c. | 3.50c. |
| Hot-rolled annealed sheets (No. 24) | 4.40c. | 4.45c. | 4.40c. |
| Hot-rolled sheets (No. 10) | 3.75c. | 3.80c. | 3.75c. |
| Galv. sheets (No. 24) | 5.00c. | 5.05c. | 5.00c. |
| Cold finished steel: Rounds and Squares and hexagons | 5.95c. 7.20c. | 5.95c. 7.20c. | 4.75c. 6.00c. |
| Flats | 7.70c. | 7.70c. | 7.00c. |
| Common wire nails—base per keg less carload | $3.40 | $3.25 | $3.35 |

All items subject to differentials for quantity.

# New Commodity Extras on Cold-Rolled Strip Steel

CROWN Fender Quality is now defined as Flat-Rolled Steel Oiled, uncoated, in coils and/or in cut lengths 30 in. to 156 in.; widths 2 in. to 23 15/16 in., inclusive, designed for use in the manufacture of Cold-Rolled Steel Automobile Parts except Lamp Stock.

Lamp Stock Quality is defined as Flat-Rolled Steel Oiled, uncoated, in cut lengths 60 in. to 120 in.; widths 12 1/16 in. to 23 15/16 in., inclusive, designed for use in the manufacture of Drawn Automobile Lamps.

Tubing and Molding Quality is defined as Flat-Rolled Steel Oiled, uncoated, in coils and/or in cut lengths 30 in. to 156 in.; widths 2 in. to 23 15/16 in., inclusive, designed for use in the manufacture of Formed Tubing and Molding.

All of the above described qualities have a carbon maximum of 0.20 per cent and gages of 14 to 22, inclusive.

Material under 2 in. is not available in crown fender quality or in the tubing and molding quality.

| | Extras for Widths under 12 1/16 In. in Coils | Extras for Cut Lengths, 30 In. or Longer to 156 In. |
|---|---|---|
| | Extra per 100 Lb. | Extra per 100 Lb. |
| Over 6 in. to 12 in. incl. | $0.05 | $0.40 |
| 2 in. to 6 in. inclusive | .10 | .50 |

**Gage Extras**

| | Extras per 100 Lb. |
|---|---|
| 14 | base |
| 15 | add $0.05 |
| 16 | add .10 |

**Gage Extras and Deductions**

| | |
|---|---|
| 17 | deduct $0.15 |
| 18 | deduct .10 |
| 19 | deduct .05 |
| 20 | base |
| 21 | add .05 |
| 22 | add .10 |

# Zinc Uncertain as Weekly Statistics Reveal 2500 Tons Sold Under 3.87½c.

## Lead May Move Up to 3.50c. as Consumers Purchase Heavily for October—Copper More Active—Tin Remains Stagnant

NEW YORK, Oct. 9.—Current business is a little better than last month. Daily sales are running well over 100 tons, and total bookings for October now aggregate over 1200 tons, mostly for January delivery. Despite this slight betterment the domestic market is still a dull affair and inclined to be nervous and depressed as a result of price weakness abroad and possibilities that new NRA developments may finally result in a discarding of price fixing and output restrictions. The price of copper in London has steadily sagged during the week to today's level of 6.37½c. a lb., c.i.f. usual Continental ports. This steady weakness can be summed up by the fact that there is simply too much copper being forced on unwilling users. In France economic recovery does not seem to have started whereas German import control is even more rigid than ever. British consumers are more active than a year ago, but commentators in that country are of the opinion that recovery is now at a standstill.

### Tin

London prices have remained practically unchanged during the seven-day period as buffer pool interests removed distress metal from the market. Straits tin at New York, however, has declined steadily with sterling during the week. Sterling was priced at $4.89⅜ this morning but quickly advanced to $4.92½ this afternoon when banks learned of the assassination of the Jugoslav king. As a result tin moved up slightly to yesterday's level of 50.75c. a lb., New York. Despite these low prices for Straits metal no domestic interest has been forthcoming. It is expected that tin plate mills must operate well over the current 45 per cent rate before much fresh business develops.

### Zinc

The trade was aware that a modest amount of price shading was being done last week, but statistics for the period were a startling revelation to most sellers. Over 5000 tons of metal was booked, and about 2500 tons called for October delivery. Almost half of the weekly sales were closed at prices under 3.87½c. a lb., East St. Louis. The statistics definitely allayed the sentiment for higher prices of yesterday, but so far most sellers are holding rigidly to 3.87½c. and many of them are not prone to make heavy forward bookings at this level. This disinclination to offer metal even further down comes from reports of definite plans to curtail Joplin ore production in order to raise prices. Concentrates are still quoted at $23 and $24 a ton, and output is still excessive at 6500 tons. However the mines insist that production will be held lower during the remainder of the year, and if prices consequently go up many refineries will be forced to raise spelter quotations.

Stocks of all grades of refined zinc showed an increase of 4600 tons in September. Shipments and production were about the same as in the preceding month, namely 22,000 tons and 26,600 tons, respectively. Total sales of Prime Western in September were 4377 tons at a weighted average price of 4.077c. a lb. Sales during the same month for subsequent delivery amounted to 1944 tons at an average price of 4.026c.

### Lead

Two prices continue to rule in this commodity, and the seller at the higher level reports that a fair amount of business has been transacted. However, as considerable metal is available at 3.45c. a lb., St. Louis, and 3.60c., New York, these prices are considered to represent the market. Many consumers are making the most of current sacrifice prices and are purchasing for stock as well as for immediate needs. Only about 10,000 tons of November metal has been placed, but October is already almost 30,000 tons sold and indications are that final deliveries for the month will exceed either August or September. The current price level of lead is indicative of the discouraging position of the industry. The price may harden somewhat but dependable firmness will only come with a definite checking of stock increases. This in turn is dependent on a curtailment in output as there is no indication that consuming industries will enjoy sufficient additional business to take up the slack. At present the trade is doubtful whether the stock decrease in August will be duplicated when September figures are released.

### The Week's Prices. Cents Per Pound for Early Delivery

| | Oct. 3 | Oct. 4 | Oct. 5 | Oct. 6 | Oct. 8 | Oct. 9 |
|---|---|---|---|---|---|---|
| Electrolytic copper, N. Y.* | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 | 8.75 |
| Lake copper, N. Y. | 9.12½ | 9.12½ | 9.12½ | 9.12½ | 9.12½ | 9.12½ |
| Straits tin, Spot, New York | 51.00 | 50.80 | 50.95 | .... | 50.75 | 50.75 |
| Zinc, East St. Louis | 3.87½ | 3.87½ | 3.87½ | 3.87½ | 3.87½ | 3.87½ |
| Zinc, New York | 4.22½ | 4.22½ | 4.22½ | 4.22½ | 4.22½ | 4.22½ |
| Lead, St. Louis | 3.45 | 3.45 | 3.45 | 3.45 | 3.45 | 3.45 |
| Lead, New York | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 | 3.60 |

*Refinery quotations; price ¼c. higher delivered in Connecticut.

Aluminum, 98-99 per cent, 22.90c. a lb., delivered; new No. 12, 19.50c. a lb., delivered.
Aluminum, remelt No. 12 (alloy), carload lots delivered, 14.00c. a lb., average for week.
Nickel electrolytic cathode, 35c. a lb., delivered; shot and ingot, 36c. a lb., delivered.
Antimony, 9c. a lb., New York.
Brass ingots, 85-5-5-5, 8.25c. a lb., New York and Philadelphia.

#### From New York Warehouse

*Delivered Prices, Base per Lb.*

| | |
|---|---|
| Tin, Straits pig | 52.50c. to 53.50c. |
| Tin, bar | 54.50c. to 55.50c. |
| Copper, Lake | 10.25c. to 11.00c. |
| Copper, electrolytic | 10.00c. to 10.50c. |
| Copper, castings | 9.75c. to 10.75c. |
| *Copper sheets, hot-rolled | 16.00c. |
| *High brass sheets | 14.50c. |
| *Seamless brass tubes | 17.00c. |
| *Seamless copper tubes | 17.25c. |
| *Brass rods | 13.00c. |
| Zinc, slabs | 5.75c. to 6.75c. |
| Zinc sheets (No. 9), casks, 1200 lb. and over | 10.25c. |
| Lead, American pig | 4.50c. to 5.50c. |
| Lead, bar | 5.50c. to 6.50c. |
| Lead, sheets | 7.50c. |
| Antimony, Asiatic | 10.00c. |
| Alum., virgin, 99 per cent, plus | 23.30c. |
| Alum., No. 1 for remelting, 98 to 99 per cent | 18.00c. to 19.00c. |
| Solder, ½ and ½ | 32.00c. to 33.00c. |
| Babbitt metal, commercial grades | 25.00c. to 60.00c. |

*These prices are also for delivery from Chicago and Cleveland warehouses.

#### From Cleveland Warehouse

*Delivered Prices per Lb.*

| | |
|---|---|
| Tin, Straits pig | 55.75c. |
| Tin, bar | 57.75c. |
| Copper, Lake | 10.00c. |
| Copper, electrolytic | 10.00c. |
| Copper, castings | 9.75c. |
| Zinc, slab | 5.75c. to 6.00c. |
| Lead, American pig | 4.75c. to 5.00c. |
| Lead, bar | 7.75c. |
| Antimony, Asiatic | 9.00c. |
| Babbitt metal, medium grade | 18.50c. |
| Babbitt metal, high grade | 60.25c. |
| Solder, ½ and ½ | 33.75c. |

#### Old Metals, Per Lb., New York

*Buying prices are paid by dealers for miscellaneous lots from smaller accumulators, and selling prices are those charged to consumers after the metal has been prepared for their uses. (All prices are nominal.)*

| | Dealers' Buying Prices | Dealers' Selling Prices |
|---|---|---|
| Copper, hvy. crucible | 6.00c. | 6.75c. |
| Copper, hvy. and wire | 5.50c. | 6.25c. |
| Copper, light and bottoms | 4.62½c. | 5.50c. |
| Brass, heavy | 2.87½c. | 3.50c. |
| Brass, light | 2.50c. | 3.12½c. |
| Hvy. machine composition | 4.50c. | 5.00c. |
| No. 1 yel. brass turnings | 4.25c. | 4.75c. |
| No. 1 red brass or compos. turnings | 4.25c. | 5.25c. |
| Lead, heavy | 2.87½c. | 3.37½c. |
| Zinc | 2.25c. | 3.00c. |
| Cast aluminum | 9.62½c. | 10.75c. |
| Sheet aluminum | 11.00c. | 12.50c. |

## Reinforcing Steel

### Awards 3300 Tons—New Projects 1200 Tons

**Oswego County, N. Y.,** 300 tons, highway, to Kalman Steel Corpn.

**New York,** 1000 tons, bars for the Department of Parks, to Carroll-McCreary Co., by lot drawing.

**Ontario County, N. Y.,** 225 tons, mesh for highway, to American Steel & Wire Co.

**Queens, N. Y.,** 100 tons, incinerators, to Kalman Steel Corpn.

**Battle Creek, Mich.,** 275 tons, Postum Co., to Concrete Engineering Co.

**Chicago,** 370 tons, Ashland Avenue bridge, to Truscon Steel Co.

**Chicago,** 365 tons, Sanitary District, to Truscon Steel Co.

**State of Illinois,** 100 tons, roadwork, to Concrete Engineering Co.

**Trempealeau, Wis.,** 350 tons, Mississippi River dam, to an unnamed bidder.

**Lualualei, T. H.,** 210 tons, radio station at Naval Base; general contract to E. E. Black, reinforcing steel to an unnamed bidder.

### NEW REINFORCING BAR PROJECTS

**St. Louis,** 325 tons, post office substructure, Fruin-Colnon Contracting Co., St. Louis, low bidder.

**State of Colorado,** 100 tons, highway work in five counties; bids Oct. 13.

**Long Beach, Cal.,** 350 tons, alterations to three schools; general contracts awarded.

**Los Angeles,** 125 tons, warehouse for Graybar Electric Co.; bids under advisement.

**Seattle,** 300 tons, Diablo power project; new bids Oct. 15.

## Cast Iron Pipe

**Barnstable, Mass.,** has awarded 700 tons of 6 to 12-in. to Warren Foundry & Pipe Corpn.

**Onset, Mass.,** has awarded 220 tons of 12-in. to Florence Pipe & Foundry Co., Philadelphia.

**Vergennes, Vt.,** closed bids last week on a round tonnage of pipe, but all bids exceeded appropriation. R. D. Wood & Co. were low bidders.

**Natick, Mass.,** will close bids Oct. 13 on 125 tons.

**Providence, R. I.,** closed bids Oct. 8 on 550 tons; United States Pipe & Foundry Co., low bidder.

**Mitchell, S. D.,** has placed 300 tons with James B. Clow & Sons.

**Mount Sterling, Ill.,** has awarded 250 tons to James B. Clow & Sons.

**Chicago** has closed bids on 320 tons of 36-in.; James B. Clow & Sons were low bidders.

**Crown Point, Ind.,** will readvertise for 100 tons for a filter plant.

**Erie, Colo.,** plans water pipe lines. Fund of $25,000 has been authorized for this and water purification plant. Jay W. McCullough and P. D. Shepperd, Majestic Building, Denver, Colo., are consulting engineers.

**Burgaw, N. C.,** plans water pipe lines. Special election will be held Oct. 20 to approve bonds for $48,000.

**Town of Milwaukee, Wis.,** Edward Prahlow, town clerk, asks bids until Oct. 16 for 3475 ft. of 8 and 16-in. for water supply. H. C. Webster, 739 Second Street, Milwaukee, is engineer.

**Roseville, Cal.,** plans 30-in. to replace present 11-in. water trunk line. Charles Cope is water superintendent.

**Sterling, Utah,** plans about 2½ miles for main water trunk line from Cove Springs.

**Sunset, La.,** plans water pipe lines. Fund of $29,000 has been secured through Federal aid for this and pumping plant. J. B. McCrary Co., Atlanta, Ga., is consulting engineer.

**Moundville, Ala.,** closes bids Oct. 18 for about 150 tons, various sizes, for water supply. Fund of $41,000 has been authorized for waterworks.

**Hatch, N. M.,** plans water pipe lines. Fund of $28,000 has been secured through Federal aid for this and other waterworks improvements. Harvey O. Garst, Engineering Building, Las Cruces, N. M., is consulting engineer.

**Checotah, Okla.,** will take bids at once for water pipe lines and filtration plant. Fund of $60,000 has been arranged. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

**Del Rio, Tex.,** will soon take bids for pipe line for replacements and improvements in San Felipe water supply. Fund of $78,000 has been secured through Federal aid.

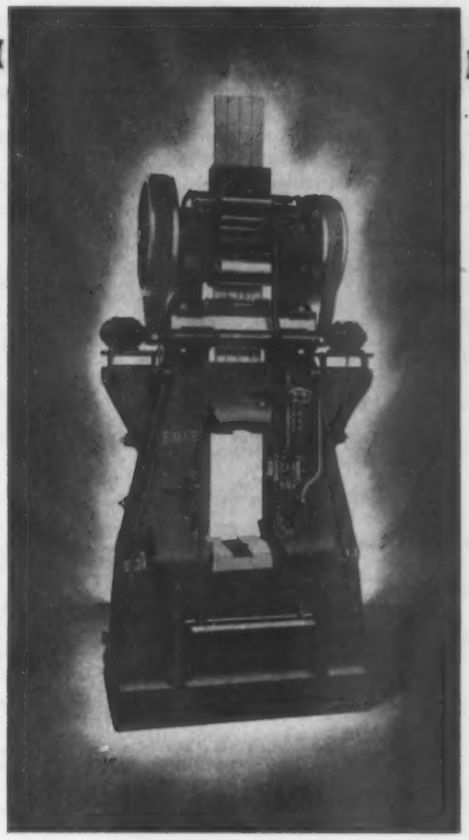
**Billings, Mont.,** plans water pipe lines. Cost about $80,000 with other extensions and improvements in waterworks. Black & Veatch, Mutual Building, Kansas City, Mo., are consulting engineers.

**Fairview, Mont.,** has awarded 180 tons of 4 to 8-in. to an unnamed bidder.

**Ekalaka, Mont.,** has let contract for 165 tons of 4 to 8-in.

**San Francisco** has taken bids on 196 tons of cast iron specials, on which Vernon Foundry Co. is low bidder.


# HEDGE YOUR BET!



Personally, we don't profess to know; your guess is as good as ours. Most of the experts, however, say we are headed for inflation. If they are right, you should invest now in goods—raw materials or equipment—forging bars or hammers. But steel rusts, and interest charges pile up, and if you buy steel, and if the experts are wrong, you take a loss.

You can't lose if you invest in equipment, for modern "ERIE" Hammers will more than carry their own charges, by making savings over your present machines. And if inflation does come, you'll be riding the top of the wave.

Hedge your bet. Buy "ERIE" Forge Shop Equipment now, and, right or wrong about inflation, you can't lose.

*"When at a Century of Progress in Chicago see the ERIE hammer and press operating at the Chrysler Motors exhibit."*

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CHICAGO: 549 WASHINGTON BLVD.
INDIANAPOLIS: 335 POSTAL STATION BUILDING
PARIS, FRANCE: 8 RUE DE ROCROY

# Fabricated Structural Steel

## Lettings Slightly Lower—New Projects in Small Volume

AWARDS of 15,700 tons are mostly in small lots and compare with 15,850 tons last week and 6030 tons two weeks ago. The largest lettings are 2720 tons for the Krebs Pigment & Color Co., Edge Moor, Del., and 2100 tons for a dam across the Mississippi River at Trempealeau, Wis. An award for 2600 tons of sheet piling for this dam also has been placed. New projects of 6400 tons are the lowest since the last week in January and compare with 12,300 tons a week ago. Included in fresh inquiries are 2500 tons for a bridge in Camden County, Mo., and 1000 tons for a suspension bridge at Grand Coulee Dam, Wash. Plate awards total more than 1000 tons. Structural steel lettings for the week follow:

### NORTH ATLANTIC STATES

**Lawrence, Mass.,** 800 tons, bridge, to Phoenix Bridge Co.

**Boston,** 300 tons, bridge repairs, to Lehigh Structural Steel Co.

**Chelsea, Mass.,** 190 tons, Soldiers Home, to New England Structural Co.

**Weybridge, Vt.,** 100 tons, bridge, to McClintic-Marshall Corpn.

**New Haven, Vt.,** 100 tons, bridge, to Lackawanna Steel Construction Co.

**Cattaraugus and Erie Counties, N. Y.,** 210 tons, highway bridge, to Ernst Iron Works.

**New York,** 185 tons, Stanton Street substation post office, to Belmont Iron Works.

**New York Central Railroad,** 470 tons, Saw Mill River bridge at East View, N. Y., to American Bridge Co.

**South Philadelphia,** 420 tons, United States Shipping Board pier, to Truscon Steel Co.

**Pittsburgh,** 215 tons, Meadow Gold Dairy buildings, to McClintic-Marshall Corpn.

**Penn Grove, Pa.,** 150 tons, high school building, to Belmont Iron Works.

**Golden Hill, Md.,** 550 tons, highway bridge, to American Bridge Co.

**Edge Moor, Del.,** 2720 tons, Krebs Pigment & Color Co. building, to American Bridge Co.

### SOUTH AND SOUTHWEST

**Newell, W. Va.,** 270 tons, building for Newell China Co., to Pittsburgh Bridge & Iron Works.

**Nogales, Ariz.,** 100 tons, immigration station, to Virginia Bridge & Iron Co.

**Cleveland,** 350 tons, building for Lincoln Electric Co., to Austin Co.

**Detroit,** 175 tons, building for Chrysler Motor Co., to Whitehead & Kales.

**Youngstown, Ohio,** 210 tons, buildings for Youngstown Steel Door Co., to Fort Pitt Bridge Works Co.

**Granite City, Ill.,** 550 tons, building for American Steel Foundries, Inc., to an unnamed fabricator.

**Prophetstown, Ill.,** 500 tons, bridge, to McClintic-Marshall Corpn.

**Chicago,** 620 tons, Lincoln Avenue bridge, to Gage Structural Steel Co.

**Harrisburg, Ill.,** 100 tons, mine tipple, to Link-Belt Co.

**State of Iowa,** 630 tons, State highway bridges, to McClintic-Marshall Corpn.

**Ringgold County, Iowa,** 140 tons, beam spans, to Illinois Steel Bridge Co.

**Butler and Shelby Counties, Iowa,** 285 tons, beam spans, to Pittsburgh-Des Moines Steel Co.

**Fargo, N. D.,** 295 tons, sewage plant, to Minneapolis-Moline Power Implement Co.

**Dunn County, Wis.,** 445 tons, bridges, to Worden-Allen Co.

**Dunn County, Wis.,** 280 tons, bridge, to Wisconsin Bridge & Iron Co.

**Minneapolis, St. Paul & Sault Ste. Marie Railroad,** 100 tons, bridge at Heafford Junction, Wis., to McClintic-Marshall Corpn.

**Menomonee, Wis.,** 225 tons, bridge, to Minneapolis-Moline Power Implement Co.

**Trempealeau, Wis.,** 2100 tons of structural and 2600 tons of sheet piling, dam across Mississippi River, to American Bridge Co.

**Charlevoix, Mich.,** 100 tons of sheet steel piling, to Inland Steel Co.

**Hibbing, Minn.,** 780 tons, memorial building, to American Bridge Co.

**Lincoln, Neb.,** 150 tons, truss bridge, to St. Joseph Structural Steel Co.

### WESTERN STATES

**Thompson Falls, Mont.,** 225 tons, bridge, to Virginia Bridge & Iron Co.

**San Francisco,** 187 tons, Piers 38 and 40, to McClintic-Marshall Corpn.

**Los Angeles,** 100 tons, Western Broadcast Co. radio towers, to Pacific Coast Steel Corpn.

**Long Beach, Cal.,** 100 tons, school alterations, to Pacific Iron & Steel Co.

**Lualualei, T. H.,** 300 tons, radio station at Naval Base, general contract to E. E. Black, steel award to an unnamed bidder.

**France Field, Canal Zone,** 250 tons, hangar at Army Air Base, to an unnamed bidder.

## NEW STRUCTURAL STEEL PROJECTS

### NORTH ATLANTIC STATES

**Andover, Mass.,** 300 tons, school.

**Camden, N. J.,** 900 tons, contract No. 6, high-speed line for Philadelphia-Camden bridge.

**Washington,** 200 tons, hangar for Goodyear Tire & Rubber Co.

### THE SOUTH

**State of Kentucky,** 235 tons, highway bridges.

**Wilmington, N. C.,** 1600 tons, steel piling, lock and dam No. 2, Cape Fear River; bids opened Oct. 9, United States Engineer office, Wilmington.

**Columbia, S. C.,** 225 tons, building.

**Cincinnati,** 125 tons, building for Remington-Rand Co.

**DeWitt, Iowa,** 185 tons, bridge for Chicago & North Western Railroad.
**State of Iowa,** 700 tons, bridges.

**Muscatine, Iowa,** tonnage not stated, dam across Mississippi River.
**Camden County, Mo.,** 2500 tons, bridge.

### WESTERN STATES

**Almira, Wash.,** 1000 tons, suspension bridge at Grand Coulee Dam, bids under advisement.

**Los Angeles,** 1055 tons, second unit of Colorado River aqueduct, Specification No. 75; bids Oct. 31.

## FABRICATED PLATE

### AWARDS

### CENTRAL STATES

**New York,** 260 tons, repairs to tanker for Socony-Vacuum Oil Co. to Federal Shipbuilding & Dry Dock Co.

**Fairport Harbor, Ohio,** 110 tons, water tank, to Chicago Bridge & Iron Works.

**Steubenville, Ohio,** 140 tons, elevated water tank, to Pittsburgh-Des Moines Steel Co.

**Portland, Ore.,** 100 tons, two anchor barges for U. S. Engineer, to Commercial Iron Works.

**Richmond, Cal.,** 100 tons, Kellogg Co. plant, to Moore Dry Dock Co.

**Los Angeles,** 290 tons, black welded pipe for Metropolitan Water District, to American Pipe & Steel Co.

**Brawley, Cal.,** 100 tons, tank, to Chicago Bridge & Iron Works.

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# August Castings Output; Other Commerce Statistics

WASHINGTON, Oct. 9.—Orders for commercial steel castings declined to 25,531 net tons in August from 41,822 tons in July, according to the Bureau of the Census. The August rate of operations was 16.3 per cent while the July rate was 26.7 per cent. In the eight months ended August of the current year bookings aggregated 340,903 tons, representing an operating rate of 27.2 per cent compared with 177,706 tons, representing a rate of 14.2 per cent in the corresponding period of last year.

August production totaled 43,735 tons, or 27.9 per cent of capacity against 46,182 tons, or 29.5 per cent of capacity in July. In the first eight months of 1934, production amounted to 339,401 tons, or 27.1 per cent of capacity, compared with 173,326 tons, or 13.8 per cent of capacity, in the corresponding period of last year.

Malleable castings orders booked during August, as reported to the bureau by 112 manufacturers, totaled 21,306 tons, compared with 21,862 tons in July and with 28,323 tons, in August, 1933. August production was 23,910 tons, as against 23,388 tons in the preceding month and 31,811 tons in the same month last year. Shipments declined in August from 27,591 tons to 25,784 tons.

August production of steel barrels, as reported by 31 manufacturers, totaled 361,852 units, compared with 598,745 units in the preceding month and with 537,801 in August, 1933. Barrel shipments declined from 608,644 units in July to 364,081 in August. Unfilled orders dropped from 727,484 on July 31 to 644,814 at the end of August.

Sixty-eight makers of steel boilers reported August orders to the bureau totaling 565,843 sq. ft., compared with 377,068 sq. ft. in July and with 944,053 sq. ft. in August of last year.

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The Ludlum Steel Co. has authorized the payment of the regular quarterly dividend of $1.625 per share on the $6.50 cumulative convertible preferred stock of the company for the quarter ended Sept. 30.

## Boston Pig Iron Market Still Very Quiet

BOSTON, Oct. 9.—Pig iron sales aggregate only a few hundred tons. Most melters have light order books. Of the major industries, the stove makers are better off than others. Textile, paper and other machinery makers are rather flat. Valve manufacturers probably will be busier later on Government war vessel orders. The average jobbing foundry is taking off only an occasional melt. Electrical appliance business is gradually tapering off, while gasoline tank and pump makers are doing very little.

A local scrap exporter has obtained vessel space and this week or next will start loading 4000 tons. Providence, R. I., exporters, however, are still unable to obtain vessel space. Dealers have marked up prices on steel turnings 25c. a ton, because one mill has released shipping instructions. The American Steel & Wire Co., Worcester, Mass., is in the market for No. 1 steel and bundled skeleton, but thus far its offers have failed to attract sellers. Because no such scrap is going via rail to Pennsylvania, brokers here have ignored the weakness in Pittsburgh prices. Brokers can secure better values from exporters.

## Aqueduct Tonnage Is Feature on Coast

SAN FRANCISCO, Oct. 8.—Attention is centered on Los Angeles, where bids are to be opened the latter part of the week by the Metropolitan Water District on the first unit of the Colorado River aqueduct. This 110-mile unit, to be constructed under Specification No. 70, will require 19,500 tons of billet steel reinforcement bars, 25,500 tons of billet steel or rail steel reinforcement bars and 750 tons of structural steel. This material is to be purchased by the district within the next 90 days. Under the different alternates, if Schedule 6S and 12S are awarded on a steel pipe basis, the required tonnage of billet steel reinforcement bars will be reduced 2810 tons to a net of 16,690 tons. To compensate for the decrease the contractor will furnish 5800 tons of plates and 980 tons of structural steel. If precast concrete syphons are awarded, the total quantity of billet steel reinforcement will be unchanged, but the contractor will furnish approximately 6150 tons of the total requirement.

Bids for the second unit, calling for 30 miles of conduit, syphons and appurtenant works, will be opened Oct. 31 under Specification No. 75. Approximately 10,500 tons of billet steel reinforcement bars, 558 tons of plates and 1055 tons of structural steel will be required. The district will purchase the reinforcement bars. However, if Schedule No. 18S is awarded on the basis of steel pipe the bar tonnage will be reduced by 1500 tons and the contractor will be required to purchase 4100 tons of plates and 170 tons of structural steel. Acceptance of precast pipe alternates will have no practical effect on the quantity of reinforcing steel, except that the steel for precast pipe, about 8400 tons, will be furnished by the contractor.

In the Northwest, bids are being taken for two bridges to be constructed at the Grand Coulee dam. Approximately 1000 tons of structural steel will be required for a suspension bridge, while the Columbia Highway bridge calls for 1600 tons of structural steel.


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## Pipe Lines

**Lindsay and Porterville, Cal.,** are arranging organization of new Public Utility District, under direction of Mayor Charles Burr, Lindsay, to build welded steel pipe line from natural gas oil fie'd district at Kettleman Hills to municipal limits. Other communities in Tulare County will be represented in new utility district and steel distribution pipe lines will be installed in different towns. Cost over $300,000.

**Iroquois Gas Corpn.,** Iroquois Building, Buffalo, is considering extensions in steel pipe line distribution system near French Road, Cheektowaga, N. Y.

**Eureka Pipe Line Co.,** Chamber of Commerce Building, Pittsburgh, plans 3-in. steel line across Elk River, Kanawha County, W. Va., for extensions in oil supply system.

**Zachary, La.,** has secured low bid from Apex Construction Co., Second National Bank Building, Houston, Tex., for steel pipe lines for gas distribution.

**Houston, Tex.,** plans extensions in steel pipe line distribution system in Magnolia Park district. Fund of $93,000 has been authorized for this and improvements in gas plant. J. M. Nagle, director, department of public works, is in charge.

**James C. Graves and V. R. D. Kirkham,** Saginaw, Mich., heading new natural gas organization, plan steel pipe lines in connection with new casinghead gas plant in Porter Township, Midland County. Cost over $100,000. Contracts have been made to furnish gas to Dow Chemical Co., Midland, Mich., and other industries in this district.

**Bureau of Supplies and Accounts,** Navy Department, Washington, asks bids until Oct. 16 for 30,000 ft. steel conduit pipe for Washington yard (Schedule 8472).

## Advisers Named For NRA Reorganization

WASHINGTON, Oct. 9. — W. L. Allen, former chairman, Sheffield Steel Corpn., Kansas City, Mo., and one of the first deputy administrators of NRA, today was appointed as special adviser on general NRA reorganization. At the same time the NRA announced the appointment of Byres H. Gitchell, New York, as special adviser on organization and functions of code authorities. These advisers will make studies in their fields and make reports and recommendations, based on their investigations to the National Industrial Recovery Board.

## A Correction

IN the article "New Methods of Extrusion Improve Lead Sheath," which appeared in THE IRON AGE of July 19, 1934, on pages 18 to 21, the author did not sufficiently emphasize the credit due to John R. Shea, of Western Electric Co. Mr. Shea was primarily instrumental in developing the process described as in use in the Baltimore cable plant of Western Electric Co., and it is unfortunate that the text, as presented, did not make this clear.

# Convention Reflects Wider Use Of Welding

*(Concluded from Page 38)*

structural steel welding committee. One paper was by Inge Lyse and N. G. Schreiner, Fritz Engineering Laboratory, Lehigh University, and the other, dealing with photo-elastic studies of seat angle problems, was by Mr. Lyse and D. M. Stewart, the latter also of Lehigh University. A report of "An Examination of Welds Made Under Field Conditions for High-Pressure, High-Temperature Steam Station Piping," by D. H. Corey, Detroit Edison Co., and A. E. White and C. L. Clark, University of Michigan, was also a feature of this session.

### Qualifying of Welders Discussed

An instructive paper on the "Use of Polarized Light as Applied to Welding Products," by E. W. P. Smith, consulting engineer, Lincoln Electric Co., and an interesting popular lecture on "Steel in Residence Construction," by F. T. Llewellyn, United States Steel Corpn., were features of the opening session of the convention.

The symposium on qualifying operators of welding equipment and expenses incurred therein was notable both for a large attendance and active discussion. Those presenting prepared discussions included W. D. Halsey, Hartford Steam Boiler Inspection & Insurance Co.; Alexander Kidd, M. W. Kellogg Co.; E. D. Debes, Bethlehem Shipbuilding Co.; H. W. Pierce, New York Shipbuilding Co.; G. D. Fish, Westinghouse Electric & Mfg. Co.; Dr. S. Lewis Hand and J. H. Zink, Heating, Piping and Air Conditioning Contractors National Association; and J. W. Owens, National Weld Testing Bureau. Two new committees have been appointed by the society, one of which, under the chairmanship of C. W. Obert, Union Carbide & Carbon Research Laboratories, will work on the "correlation of code requirements for qualification of operators of welding equipment." The other, headed by A. Vogel, General Electric Co., will investigate the feasibility of coordinating codes on welding.

# Proposed Capital-Labor Truce

*(Concluded from Page 41)*

oratorical persuasion of William Green, president of the American Federation of Labor, stemmed the tide. Therefore, the Administration will have to provide some sedative for strike hysteria in the plans for peace.

### Industry's Load Already Heavy

The unions are at present overlooking certain economic facts in their constant pressure on industry. It is historic that union chiefs have generally shown no interest in industry's balance sheets. Industry is carrying a heavy load already as a result of the NIRA. Can it be expected to ignore economic influences by maintaining high wages in the face of current heavy losses? This question looms ominously in the immediate picture.

The hopes of national unions are centered on sweeping unionization, which implies socialization of labor effort. They would place a pseudo power in the hands of union constituents that would defeat individual initiative. National progress has not thus far been accomplished by regimentation of effort. Rather has advancement been scored by competitive effort, abetted by capital subscription. In a democracy, one without the other is ineffectual. Capital investment is usually guided by competitive judgment, and resultant income depends upon the marriage of capital initiative with labor. The fruits of such union must be shared on a sound basis, and not dictated by external professional influence.

In recent prosperous eras, who can deny that labor has shared in the returns of industry? In the past decade, capital and labor have met on common ground. Records are manifold of the increasingly closer relationship between management and employees; at least, until the infliction of emergency legislation. No contention is made here that industry's escutcheon is entirely free from taint, but it is certain that industry has purged itself of many evils, to the benefit of labor. Political paternalism, on the other hand, has bred the bacteria of false power among professional unions, which have tried to spread the disease among the ranks of satisfied workers, whose willingness to work has found articulate expression in almost every important steel-making center.

### Clarification Must Precede Real Truce

In its plans for a truce, the Administration will have to become cognizant of many situations it heretofore has failed to face squarely. To summarize briefly, it first must offer a clear, unequivocal interpretation of Secton 7-a, particularly as it relates to "majority rule." It must recognize the necessity for restricting union activities, bearing in mind the extremely low percentage of industrial workers represented by professional unions. It must further recognize economic influences and not attempt to fix wages in the face of sharply fluctuating demand, unless, of course, Government subsidy for sustained industrial engagement is being considered. And, finally, in addition to many other New Deal vagaries, the constitutional powers of various Governmental labor bodies must be determined for industry's guidance.

Because those points have not been clear, capital and labor have unwittingly drawn apart. Further Federal countenancing of professional union opportunistic activities among neutral groups of workers will bring only continued strife—parting of the ways. Only out of a cooperative union, and not a "shot-gun wedding" of management and labor, can be born, without the natal attendance of violence, a new era of industrial peace.

So far as the steel industry is concerned, the cause of industrial peace seems to be well served by sincerely executed employee representation plans.

## Improved G-E Single-Operator Arc Welders

*(Concluded from Page 42)*

indicating welding current and voltage. All controls are labeled. Drip-proof construction protects all working parts from damage by water and other foreign materials. The entire set is low-hung on a three-wheel truck, and may be safely tipped as much as 22 deg. from the vertical.

## Welding Clinic At New Orleans

A FOUR-DAY welding clinic at New Orleans beginning Oct. 24 has been arranged by the Linde Air Products Co., New York. Welding and cutting equipment, including recent developments, will be demonstrated and there will be exhibits of unique and standard applications of these oxy-acetylene processes. This clinic, to be held at the Isaac Delgado Central Trades School, is the fourth sponsored by the Linde company this year, the others having been at Birmingham, Houston, Tex., and at Cleveland.

## Railroad Rate Hearing Announced

WASHINGTON, Oct. 9.—With railroads completing their side of the case, the proposed general rate increase hearing before the Interstate Commerce Commission was adjourned last Friday subject to further order of the commission. Meanwhile, Commissioner Aitchison, heading the division which is conducting the hearing, set a tentative program for further hearings for shippers which he said was "good enough to guide" them.

The tentative schedule follows:

Denver, Colo., Oct. 26-27.

Salt Lake City, Utah, Oct. 29-31.

Portland, Ore., Nov. 2, 3, 5, 7.

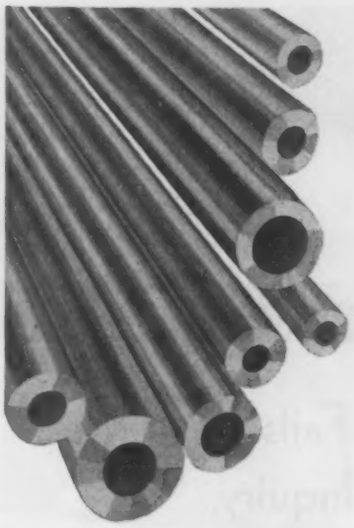
San Francisco, Nov. 9 and 10 and possibly Nov. 12.

Chicago, Nov. 16.

Washington, Nov. 26.

Birmingham, Ala., and Dallas, Tex., before examiners, Nov. 7.

In asking for the rate increase, generally 10 per cent, the carriers put in an estimate of $172,345,000 which they said they thought would be obtained in additional revenues. Mr. Aitchison suggested that the figure be broken down in order to get an estimate of the additional revenue for each railroad.

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## OBITUARY

DR. CALVIN W. RICE, since 1906 secretary of the American Society of Mechanical Engineers, died suddenly in New York, on Oct. 2, aged 65 years. After his graduation from Massachusetts Institute of Technology in 1890, he became identified with the Thomson-Houston Electric Co. and continued with that company and its successor, the General Electric Co., until 1895. From that time to 1906 he spent in mining and public utility projects, including work as electrical engineer with the Brooklyn Electric Light & Power Co., as chief of the meter and testing department of the New York Edison Co., and as consulting engineer with the General Electric Co. from 1904 to 1906. Doctor Rice was a member of the Corporation, Massachusetts Institute of Technology, secretary and member of the board of the New York Museum of Science and Industry and member of a number of scientific societies here and abroad. He was made Doctor of Engineering by the Technische Hochschule, Darmstadt, Germany, in 1926.

DR. CALVIN W. RICE

❖ ❖ ❖

CALVIN P. RICHTER, metallurgist for the Republic Steel Corpn., died suddenly at Clearfield, Pa., on Sept. 30, aged 45 years. After his graduation from Purdue University in 1913, he spent four years as chemist with the Grasselli Chemical Co. and the C. R. Cook Paint Co. He then became connected with the Central Steel Co. at Massillon as metallurgist. Since that time he had been identified with the Central Alloy Steel Co. and the Republic Steel Corpn. and had been in the company's Detroit office since early in 1928.

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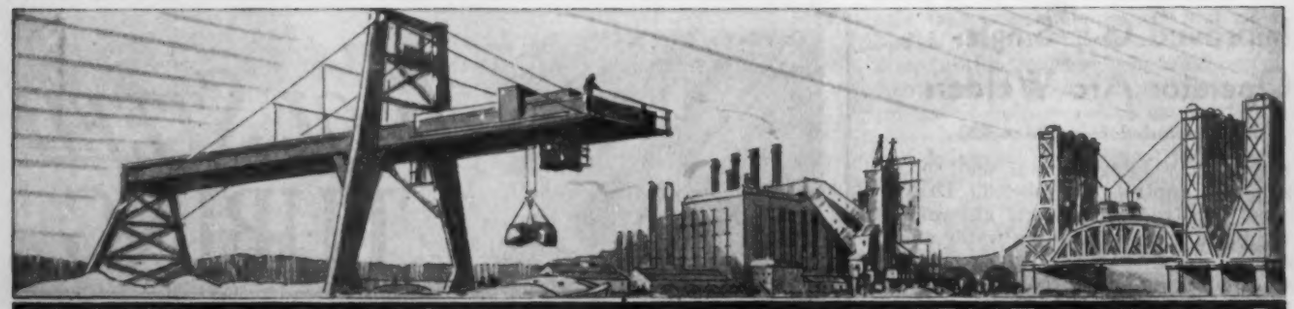
A. WALTER LORENZ, for 18 years head of the research laboratories of the Bucyrus-Erie Co., South Milwaukee, Wis., died Oct. 1 after a long illness. He was 44 years of age.

For the high-speed stream-lined trains recently announced for Baltimore & Ohio service, eight of the cars being built by American Car & Foundry Co. will be equipped with Hyatt roller bearing journal boxes. Several years ago the Baltimore & Ohio was among the first to employ anti-friction bearings in railroad service when Hyatt roller bearings were installed in one of its engine tenders. Since that time a number of its passenger train cars have been so equipped.



# PLANT EXPANSION AND EQUIPMENT BUYING

## Machine Tool Buying Fails to Keep Pace with New Inquiry

ALTHOUGH new inquiries for machine tools continue to come out in fair volume, and most of the leading makers have a large amount of prospective business on their books, orders are still very light. Current awards are made up almost entirely of single tools which represent very pressing needs of buyers. Sizable tooling programs are entirely lacking, even in the automotive industry.

Lower Michigan companies are very slow in deciding about their 1935 programs, but obviously intend to keep new tooling activities at a minimum. One large automobile producer is definitely committed to a policy of rebuilding its tools whenever possible and its potentialities as a tool buyer have thus been definitely reduced.

### BUFFALO DISTRICT

**Acheson-Graphite Co.,** Buffalo Avenue and Portage Road, Buffalo, has let general contract to Walter S. Johnson Building Co., 2532 Hyde Park Boulevard, for one-story addition, 60 x 255 ft., for storage and distribution. Cost about $35,000 with equipment.

**Rochester Gas & Electric Co.,** Rochester, N. Y., plans extensions in electrical distribution lines at Webster, N. Y., and vicinity. Cost over $40,000 with equipment.

**Liquid Carbonic Canadian Corpn.,** Mill Street, Toronto, manufacturer of carbonating and bottling machinery, liquid carbonic gas, etc., a subsidiary of Liquid Carbonic Co., Chicago, has approved plans for one-story addition. Cost over $100,000 with equipment.

**Department of Mental Hygiene,** State Office Building, Albany, N. Y., asks bids for power equipment for central steam heating service at State school, Newark, N. Y.

### NORTH ATLANTIC

**Colonial Distilling & Distributing Co.,** 390-92 Greenwich Street, New York, has leased five-story adjoining building, 44 x 160 ft., for expansion in storage and distributing division.

**Eagle Pencil Co.,** 703 East Thirteenth Street, New York, plans one-story addition to plant of Canadian subsidiary, Eagle Pencil Co., Ltd., Drummondsville, Que. Cost about $40,000 with equipment.

**Tide Water Oil Co.,** 17 Battery Place, New York, will install steel tanks, with capacity of about 6,800,000 gal., at new bulk oil storage and distribution plant at Syracuse, N. Y., where six and one-half acre tract was recently acquired. Buildings to be constructed will include pumping station, motor truck service, repair and garage building, warehouse units, etc. Cost close to $100,000 with equipment. Company has begun work on similar plant in harbor district, Boston, where 45 acre tract recently was purchased. Cost about $150,000 with tanks and equipment.

**Union Free School District No. 15, Hempstead, L. I.,** plans manual training department in three-story high school at Lawrence, L. I., for which general contract is being let to Psaty & Fuhrman, Inc., 369 Lexington Avenue, New York, low bidder at $554,720. Fund of $825,000 has been secured through Federal aid for building and equipment.

**Mathieson Alkali Works, Inc.,** 250 Park Avenue, New York, manufacturer of industrial chemicals, etc., is completing initial buildings at new plant at Lake Charles, La. Proposed to have plant ready for operation in December. Cost over $5,000,000 with equipment.

**Queens Borough Oil Burner Corpn.,** Flushing, L. I., has been organized by Clyde C. Goodman, 260-01 Kensington Place, Great Neck, L. I., and Henry W. Collins, 1623 East Twelfth Street, Brooklyn, to manufacture oil burners and oil-burning equipment.

**Bureau of Supplies and Accounts,** Navy Department, Washington, asks bids until Oct. 9 for special hydraulic expansion bellows (Schedule 3458) for Brooklyn Navy Yard; air ejectors and spare parts (Schedule 3435) for Brooklyn and Charleston yards; automatic visual type echo sound equipment (Schedule 3451) for Brooklyn, Philadelphia and Charleston yards; acetylene and oxygen regulators, discharge valves, pressure gages, etc. (Schedule 3445) for Brooklyn and Mare Island yards.

**Board of Education,** Tannersville, N. Y., plans manual training department in new multi-story senior and junior high school. Cost over $300,000. R. R. Graham, 25 Prospect Street, Middletown, N. Y., is architect; Elwyn E. Seelye & Co., 101 Park Avenue, New York, are consulting engineers.

**Eastern Air Lines, Inc.,** 1775 Broadway, New York, operating air transport lines between New York and Miami, Fla., New Orleans, and other points, plans expansion and improvements, including purchase of new flying equipment, shop and repair facilities, mechanical equipment, etc. Cost over $500,000. Work is scheduled to begin early next year.

**Western Wire Forming Co.,** Newark, N. J., has been organized by John W. and Kenneth W. Eckstedt, care of Jacob Slavitt, 17 Academy Street, representative, to manufacture wire products.

**State Purchase Commissioner,** State House, Trenton, N. J., asks bids until Oct. 17 for snow plows.

**National Tool & Die Co.,** Twelfth Street, Kenilworth, N. J., manufacturer of tools, dies and kindred products, is completing one-story addition, 24 x 48 ft.

**Bureau of Yards and Docks,** Navy Department, Washington, will receive bids (no closing date stated) for new buildings at Naval Aircraft Factory, Philadelphia (Specification 7719). This will comprise initial work on expansion at local plant for manufacture of airplanes and parts, aircraft motors, etc., including assembling facilities. Fund of about $2,700,000 has been authorized.

**Sun Oil Co.,** 1608 Walnut Street, Philadelphia, plans new bulk oil storage and distribution plant at Cincinnati, with battery of eight steel tanks. Cost about $100,000 with equipment.

**Bureau of Supplies and Accounts,** Navy Department, Washington, asks bids until Oct. 16 for 200 engine cylinder thermometer indicators (Schedule 3422), 200 aircraft oxygen regulators (Schedule 3435); until Oct. 19, corrosion-resisting steel tubing (Schedule 3471) for Philadelphia Navy Yard; until Oct. 16, tool steel for Philadelphia and Washington yards (Schedule 3475).

### WESTERN PENNA.

**United States Engineer Office,** Pittsburgh, asks bids until Oct. 29 for new operation building at Montgomery Island lock and dam, Ohio River (Circular 106).

**Cronin China Co.,** New Cumberland, W. Va., has acquired two former potteries of Owen China Co., at Minerva, Ohio, and will remodel for new plant, with circular tunnel kilns, kiln cars, conveyors and other machinery. Cost over $200,000 with equipment.

**Frozen Carbonic Corpn.,** Neville Island, Pittsburgh, care of Hannah & Sterling, Grant Building, architects, plans new one-story dry ice-manufacturing plant, 50 x 85 ft. Cost about $40,000 with machinery.

**Clarion Broadcasting Co., Inc.,** Clarion, Pa., J. V. Ketley, president, plans new radio broadcasting station, with power station, steel tower and other structures. Cost about $40,000 with equipment.

### NEW ENGLAND

**Commanding Officer,** Springfield Armory, Springfield, Mass., asks bids until Oct. 15 for one pedestal drill grinder (Circular 21).

**School Board,** Andover, Mass., plans manual training department in new multi-story junior high school, for which bids on general contract will close Oct. 13. Power house will be built for central steam-heating. Cost about $400,000. Perley F. Gilbert, Central Block, Lowell, Mass., is architect; Kilham, Hopkins & Greeley, 126 Newbury Street, Boston, are consulting architects.

**Electrolux, Inc.,** 500 Fifth Avenue, New York, manufacturer of vacuum cleaners, parts, etc., has let general contract to John L. Duge & Sons Co., 148 Railroad Avenue, Greenwich, Conn., for two-story addition to plant at Old Greenwich, 86 x 135 ft., for storage and distribution. Cost about $40,000 with equipment. H. K. Ferguson Co., Cleveland, is architect and engineer.

**Public Works Branch,** Treasury Department, Washington, asks bids until Oct. 16 for parcel post mail-handling equipment for Boston post office.

**Board of Water Commissioners,** Town Hall, Townsend, Mass., has plans for new pumping plant for municipal water system. Whitman & Howard, 89 Broad Street, Boston, are consulting engineers.

**Brauner Mfg. Co.,** Haverhill, Mass., has been organized by L. H. Karelitz and L. Murphy,

NRA CODE

# CUT MATERIALS HANDLING COSTS

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6 Eleventh Avenue, to manufacture mechanical equipment and parts.

**School Board**, Bourne, Mass., plans installation of a manual training shop in two-story addition to high school, 64 x 110 ft. Cost about $125,000. S. W. Haynes & Associates, 336 Main Street, Fitchburg, Mass., are architects.

**William H. Morgan**, Lincoln Park, Greenwood, R. I., has started erection of a machine shop addition. Hanson & Erickson, Inc., Greenwood Avenue, Greenwood, is general contractor.

## SOUTH ATLANTIC

**City Clerk, City Hall**, Fayetteville, N. C., asks bids until Oct. 19 for fabricating, delivering and erecting one full circle revolving crane in connection with new dock and wharf on Cape Fear River, for which bids are being received at same time. Walter F. Schulz, Shrine Building, Memphis, Tenn., is consulting engineer.

**American Granite Quarries, Inc.**, Elberton, Ga., has approved plans for one-story fabricating, polishing and finishing mill, 54 x 350 ft., with two electric cranes, sandblast equipment, surfacing and polishing machines, cutting equipment and other machinery. Cost over $60,000 with equipment. Company is affiliated with Allen Granite Co. and National Granite Co., same place.

**Automatic Anti-Freeze Device Corpn.**, Kingstree, S. C., has been organized by H. B. Dobson, Kingstree, and associates, to manufacture mechanical equipment and devices.

**Common Council**, New Bern, N. C., plans new one-story city-owned canning plant, 50 x 200 ft. Cost close to $25,000 with equipment. Mayor L. C. Scott is active in project.

**Virgin Islands Co.**, St. Thomas, V. I., West Indies, has taken title to former Bethlehem sugar mill near St. Croix, including about 2200 acres of sugar cane lands, and will remodel for modern cane sugar mill. Cost over $200,000 with machinery. Company is subsidized by United States Government and has secured fund of $1,000,000 from PWA for development of different industries.

## WASHINGTON DISTRICT

**Bureau of Supply, Procurement Division**, Treasury Department, Washington, asks bids until Oct. 16 for conduit couplings, grease and oil cups, valves, valve disks, flanges, pipe hangers, nipples, unions, extension bars, beam clamps, elbows and other pipe fittings required from Jan. 1-Dec. 31, 1935 (Class 45).

**Southern States Cooperative Mills**, 2101 East Fort Avenue, Baltimore, has let general contract to Rust Engineering Co., Pittsburgh, for grain elevator unit, 116 ft. high; storage and distribution building, 35 x 100 ft., and other structures. Cost about $125,000 with elevating, transmission, screening and other equipment. Carlstrand Engineering Co., 10 West Chase Street, Baltimore, is engineer.

**Bureau of Yards and Docks**, Navy Department, Washington, asks bids until Nov. 28 for motor-driven and hand-operated winches and antennas at Naval Radio Station, Summit, Canal Zone (Specification 7800); similar winches for Naval Radio Station, Lualualet, Oahu, T. H. (Specification 7801).

**Commanding Officer**, Aberdeen Proving Ground, Aberdeen, Md., asks bids until Oct. 15 for rigid galvanized conduit, metallic parkway cable, conduit galvanized elbows, cable, etc. (Circular 30).

**Bureau of Supplies and Accounts**, Navy Department, Washington, asks bids until Oct. 16 for one motor-driven metal-cutting openside planer (Schedule 3427) for Eastern or Western navy yard.

## OHIO AND INDIANA

**American Coach & Body Co.**, 3809 Clark Avenue, S. W., Cleveland, manufacturer of automobile bodies, has let general contract to H. E. Klefman Co., 3404 Lorain Avenue, for one-story addition.

**Public Utilities Department**, City Hall, Cleveland, plans extensions and improvements in municipal electric light and power plant, with installation of new equipment. Cost about $250,000 with machinery.

**Kroger Grocery & Baking Co.**, 35 East Seventh Street, Cincinnati, will soon take bids on general contract for new power house. Cost over $100,000 with boilers, fuel pulverizer, conveyors and other equipment. Tietig & Lee, 34 West Sixth Street, are architects; Fosdick & Hilmer, Union Trust Building, are consulting engineers.

**Material Division, Air Corps**, Wright Field, Dayton, Ohio, asks bids until Oct. 16 for 10 oil cooler bracket assemblies, 10 oil cooler mounting cowl plates, 10 oil front cooler supports, 75 oil temperature regulator mounting plates, 50 carburetor air intake tube sleeves, 50 carburetor air intake tube supports, 50 tail wheel fork assemblies, 300 engine bearer washers, 80 gun track supports brackets, 750 bolt assemblies, etc. (Circular 150), 400 computer assemblies (Circular 164); until Oct. 17, one bench lathe, back gear (Circular 155); until Oct. 18, 1352 low pressure oxygen connection assemblies (Circular 160); until Oct. 19, air intake tube support assemblies, oil cooler brace assemblies, etc. (Circular 161); until Oct. 22, 264 wheel assemblies and 176 brake assemblies (Circular 152).

**Servel, Inc.**, Evansville, Ind., manufacturer of gas-operated refrigerators, parts, etc., has let general contract to International Iron & Steel Co., Evansville, for one-story addition. Cost over $50,000 with equipment.

## SOUTHWEST

**Eagle Bottling Works**, 1903 Cherry Street, Kansas City, Mo., plans new four-story and basement brewery. Cost over $200,000 with equipment. Power house will be built. A. B. Anderson, Davidson Building, is architect; George Wentzel, last noted address, is consulting engineer.

**Greyhound Machine Works, Inc.**, Smackover, Ark., has been organized by E. E. Bellar and O. F. Matthews, Smackover, to manufacture machinery and parts, and operate a general machine works.

**Custodian, United States Post Office**, Okmulgee, Okla., asks bids until Oct. 15 for coal-burning hot water heater, tank, ash hoist and accessory equipment.

**Common Council**, Marshall, Mo., plans extensions and improvements in municipal electric light and power plant, including new turbine unit, boilers, pumps and accessories. Cost over $85,000 with equipment. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

**H. Sokolik Packing Co.**, 1719 North Vandeventer Avenue, St. Louis, meat packer, plans multi-story addition. Cost close to $50,000 with equipment.

**United States Engineer Office**, Postal Telegraph Building, Kansas City, Mo., asks bids until Oct. 16 for two turbo-generator sets (Circular 139).

**Board of Public Works**, City Hall, Kansas City, Kan., plans new municipal grain elevator and dock on Missouri River levee, with tanks, screening and elevating equipment, conveying machinery, etc. Dock will include freight-handling and other mechanical equipment. Fund of $1,700,000 has been arranged through Federal aid. Horner & Wyatt, Board of Trade Building, Kansas City, Mo., are consulting engineers; Walter F. Schulz, Shrine Building, Memphis, Tenn., is associate engineer.

**Southern San Antonio Independent School District**, 349 Main Avenue, San Antonio, plans manual training department in new high school. Cost close to $100,000. Phelps & Dewees, Gunter Building, San Antonio, are architects.

## MIDDLE WEST

**United States Engineer Office**, Federal Building, Rock Island, Ill., asks bids until Oct. 24 for improvements in works-lock, side lock and dam No. 20, Mississippi River, near Canton, Mo., including 2550 lb. steel castings, iron castings, steel forgings, 11,100 lb. reinforcing steel, corrugated galvanized metal pipe, etc. (Circular 60).

**Dearborn Paper Co.**, 860 Rees Street, Chicago, has plans for new one-story paper converting, storage and distribution plant, 130 x 460 ft. Cost about $80,000 with equipment. J. M. LaPoint is company engineer.

**Common Council**, La Salle, Colo., plans new municipal electric light and power plant, using Diesel engine-generating unit. Bond issue of $42,000 is being arranged.

**Samuel Coldis**, Alexandria, Minn., is at head of project to build local brewery, with main unit, 45 x 90 ft., and power house, 20 x 26 ft. Burlingame & Hitchcock, Sexton Building, Minneapolis, are engineers in charge.

**Signal Corps Procurement District**, 1819 West Pershing Road, Chicago, asks bids until Oct. 16 for insulated cable and one reel (Circular 15).

**Keystone Brass Products Corpn.**, 201 North Wells Street, Chicago, has been organized by Frank Pasche and associates to manufacture brass, bronze and kindred metal products.

**Lehigh Briquetting Co.**, Dickinson, N. D., manufacturer of fuel briquettes, plans new units near Dickinson. Cost about $400,000 with equipment. Financing is being arranged in that amount. W. F. Burnett, 322 Fifth Street North, Fargo, N. D., is representative.

**Dubuque Packing Co.**, Sixteenth and Sycamore Streets, Dubuque, Iowa, meat packer, has let general contract to W. L. Yokom, Inc., Roshek Building, for two-story addition, 100 x 120 ft. Cost about $100,000 with equipment. H. Peter Henschien, 59 East Van Buren Street, Chicago, is architect and engineer.

**Joseph M. Sanders**, 5453 West Lake Street, Chicago, operating a machine works, has organized J. M. Sanders Mfg. Corpn., to manufacture vending machines and parts.

**G. Heileman Brewing Co.**, 1018 South Third Street, La Crosse, Wis., has plans by Otto A. Merman, architect, Gateway City Bank Building, for new stock house, 50 x 100 ft., three stories and basement. Cost $60,000 with tanks, piping and other equipment.

**City Council**, Menominee, Mich., has authorized mayor and city clerk to enter into agreement with Government for loan of $803,000 for new municipal power and light plant. Steam or Diesel type of plant is planned. A. B. Siegel is city clerk.

## MICHIGAN DISTRICT

**Packard Motor Car Co.**, 1580 East Grand Boulevard, Detroit, has leased a three-story factory at East Windsor, Ont., for new parts and assembling plant of Canadian Packard Motor Car Co., Windsor, which will remove present works to new location, with additional equipment for production of new low-priced model Packard automobiles. L. L. Roberts is manager of Canadian branch.

**Lakeside Brewery Co.**, Port Huron, Mich., recently organized by Edward Cole, 2937 Leslie Street, Detroit, and associates, with capital of $275,000, has acquired former plant of Port Huron Brewing Co. and will remodel. Cost over $85,000 with machinery.

**George B. Bright**, 2615 Twelfth Street, Detroit, engineer, has plans for new precooling and cold storage plant at Benton Harbor, Mich., for company being organized by George H. Kittredge, Detroit, and associates. Cost about $85,000 with refrigerating machinery, conveyors and other mechanical equipment.

**National Parts Co., Inc.**, 904 East Sheridan Avenue, Lansing, Mich., has been organized by Albert K. Steigerwalt, 1048 Chesterfield Parkway, East Lansing, and associates, to manufacture automobile parts and equipment.

## SOUTH CENTRAL

**Ashland By-Products Coke Co.**, Ashland, Ky., plans new local terminal on Ohio River, near Lock and Dam No. 29, including floating dock, conveyor system with steel transfer tower, rail transfer tower, telescopic belt conveyor, etc. Federal permission has been asked.

**Director of Purchases**, Tennessee Valley Authority, New Sprankle Building, Knoxville, Tenn., asks bids until Oct. 25 for one 85-ton gantry crane for Wheeler power plant.

**City Council**, Memphis, Tenn., has called for vote of citizens at general election, Nov. 6, to approve bonds for $9,000,000 for municipal electrical distribution system for power supply from transmission system of Tennessee Valley Authority, including substations and switching stations.

**Construction Service**, Veterans' Administration, Washington, asks bids until Nov. 6 for deep-well pumping machinery and accessories for pumping plant at institution, Alexandria, La.

**Cummins Distillery Corpn.**, Louisville, care of Walter C. Wagner, Breslin Building, Louisville, architect, is razing old distillery buildings at Athertonville, Ky., and will soon begin superstructure for new units. Other structures will be remodeled and improved. Cost close to $200,000 with machinery.

**Slumber Products Corpn.**, 738 South Dudley Street, Memphis, Tenn., manufacturer of spring mattresses, etc., plans early rebuilding of

**PRIVATE homes now vie with foundries and other industries as consumers of coke. Last winter 100,000 families burned coke specially produced for home heating by Interlake plants.**

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plant recently destroyed by fire. Loss over $125,000 with equipment.

**Common Council,** Gallatin, Tenn., asks bids until Oct. 15 for waterworks equipment, including pipe lines, etc. C. N. Harrub Engineering Co., American National Bank Building, Nashville, Tenn., is consulting engineer.

## PACIFIC COAST

**Bureau of Reclamation,** Denver, asks bids until Oct. 15 for crane rails and accessories for 300-ton generator room cranes, also for 50-ton machine shop crane and 10-ton pipe shop crane, Boulder power plant, Boulder Canyon Project, California-Arizona (Specification 629-D).

**Bureau of Supplies and Accounts,** Navy Department, Washington, asks bids until Oct. 16 for two motor-driven metal cutting saw machines (Schedule 3438); until Oct. 19, 3250 doz. hack saw blades (Schedule 3444) for Mare Island Navy Yard; until Oct. 16, corrosion-resisting bar steel (Schedule 3418) for Mare Island and Puget Sound yards; one motor-driven power hack saw (Schedule 3443) for Puget Sound yard; until Oct. 23, 12 hoist control equipment, push button stations and spare parts (Schedule 3477) for Puget Sound yard.

**Allis-Chalmers Mfg. Co.,** Portland, Ore., manufacturer of electrical and mechanical equipment, mining machinery, etc., with headquarters at Milwaukee, Wis., plans rebuilding factory branch, storage and distributing plant recently destroyed by fire. Loss over $75,000 with equipment.

**Consolidated School District No. 9,** Benton County, Corvallis, Ore., H. L. Mack, Corvallis, clerk, plans installation of manual training department in new high school, for which bids have been asked on general contract. Cost about $275,000. Whitehouse, Stanton & Church, Railway Exchange Building, Portland, are architects.

**Oregon State Highway Commission,** State Office Building, Salem, Ore., has plans for new highway equipment repair shop and maintenance building at Roseburg, Ore., 32 x 96 ft. R. H. Baldock, Public Service Building, Portland, is State highway engineer.

**Constructing Quartermaster,** Fort Mason, Cal., has plans for new parachute and armament buildings at France Field, Canal Zone, for which bids are being asked by Constructing Quartermaster, Quarry Heights, Canal Zone, until Nov. 5. Appropriation of $86,964 has been authorized.

## FOREIGN

**Sigua Manganese Corpn.,** Santiago, Cuba, recently organized, care of Luis Batile, Santiago, plans development of manganese properties in Cuba, with installation of mining and other equipment. A stock issue of $250,000 is being arranged, part of fund to be used for purpose noted.

**Charles Churchill & Co., Ltd.,** Birmingham, England, manufacturer of machine tools, parts and other mechanical equipment, has plans for new one-story plant. Cost over $250,000 with machinery.

**British Northrop Looms Co., Ltd.,** Blackburn, Lancashire, England, manufacturer of automatic looms for textile mills, has approved expansion program to more than double present capacity, including one-story foundry, now under way, and other units.

# Behavior of Structural Steel Under Fire Conditions Now Being Studied

THE extreme importance of proper fire protection of load-bearing steel columns in a building and the influence of the proportions of the column and of the metal used on the column's ability to bear its load during a severe fire have been brought out by a number of tests at the Bureau of Standards, Department of Commerce.

The steel used in building construction is designed to carry its normal load with a considerable margin of safety. If, however, a fire occurs in the building and the steel is heated to temperatures approaching red heat it becomes much weaker than when cold. For many years the bureau, in cooperation with others interested, has conducted fire tests of building constructions, testing separately such members as columns, walls, partitions and floors.

In the tests of building columns it was found, for example, that an unprotected steel column subjected to a fairly severe test fire might fail under its ordinary working load within 10 or 15 min., while the same column protected by two to four inches of concrete, brick, gypsum or other suitable material properly placed so that it would not crack or fall off during the fire would remain cool enough to carry its load during a fire exposure of as much as 6 or 8 hr., which is as long an exposure as would occur even in a severe fire.

In analyzing the results of such tests it became evident that supplementary information was needed concerning the strength of steel itself at various temperatures. Accordingly, a series of laboratory tests was arranged from which such information could be obtained. In this work, test specimens about 10½ in. long with flat ends were used.

The specimen was inclosed in a specially designed furnace in which the temperature could be controlled and measured accurately. The specimen in the furnace was subjected to a compressive load which could also be controlled and measured. Tests were made either by bringing the specimen to a constant temperature and then applying increasing loads and noting the changes in length until failure occurred or by maintaining a known constant load on the specimen and raising the temperature continuously and again noting the changes of length until failure occurred. In the constant-load tests the specimen expanded when first heated, but as heating was continued a temperature was finally reached at which the specimen began to shorten.

Since the specimens were tested in compression it was to be expected that the load supported per unit area of section of the column would depend greatly upon the shape, thickness of parts and ratio of its length to lateral dimensions. The slenderness of the specimens is expressed in terms of the ratio $l/r$, where $l$ is the length of the specimen, and $r$ is the least radius of gyration of the cross-section. The values of $l/r$ for the various specimens ranged from 20 to 150. Specimens of structural steel shapes and round bars were used, the diameters of the bars ranging from ¼ in. up to 1⅞ in. Some cast iron specimens were also included. The heavier steel specimens were stronger at 482 deg. F. than at room temperature. In general, the test specimens failed to carry the loads for which steel columns are originally designed, at temperatures from 986 deg. to 1166 deg. F. The load which a given column would carry at any temperature in the range 932 deg. to 1175 deg. F. can be represented by a fairly simple empirical formula.

The thermal expansion of test specimens under no load was also determined. The results, together with the tests under load, indicate that if steel building members are restrained by the surrounding construction and heated to a high temperature the stresses induced by the restraint may become higher than those due to the supported load.

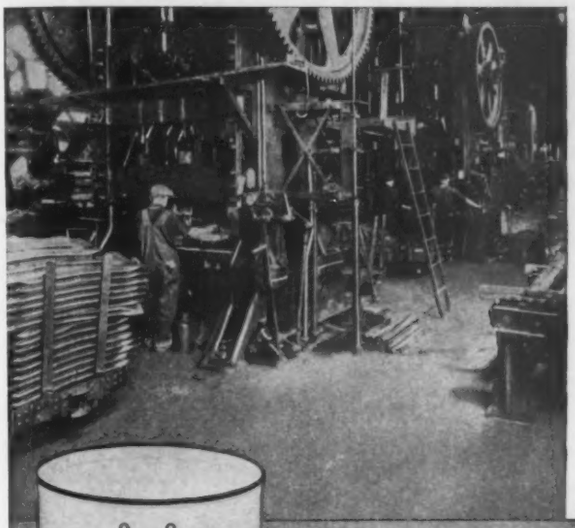
# W. B. Stout to Head S.A.E.

NOMINATION of William B. Stout, president, Stout Engineering Laboratories, Inc., as president of the Society of Automotive Engineers for 1935 has been announced by John A. C. Warner, secretary and general manager of the S.A.E. Nine vice-presidents, one representing each professional activity of the society, have also been named. They are: C. H. Chatfield, assistant director of research, United Aircraft & Transport Corpn.; P. B. Taylor, chief engineer, Wright Aeronautical Corpn.; C. L. Cummins, president, Cummins Engine Co.; D. P. Barnard, assistant director of research, Standard Oil Co.; L. P. Kalb, chief engineer, Continental Motors Corpn.; C. O. Richards, body engineer, Cadillac Motor Car Co.; V. P. Rumely, Hudson Motor Car Co.; T. C. Smith, engineer, motor-vehicles and construction apparatus, American Telephone & Telegraph Co., and C. O. Guernsey, chief engineer, J. G. Brill Co. David Beecroft, Bendix Aviation Corpn., New York, has been renominated as treasurer.

The executive committee of the National Industrial Traffic League does not for the present take any position either for or against the application which the railroads have filed with the Interstate Commerce Commission for an increase in freight rates and charges. The league's special committee and council have been authorized to attend the hearing and develop such information as in their judgment will clarify the application of the railroads so that members of the league may be advised thereof.

# From Design and Engineering to Assembled Product

# COMPLETE PRESSED STEEL SERVICE



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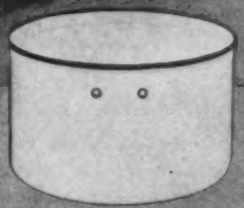
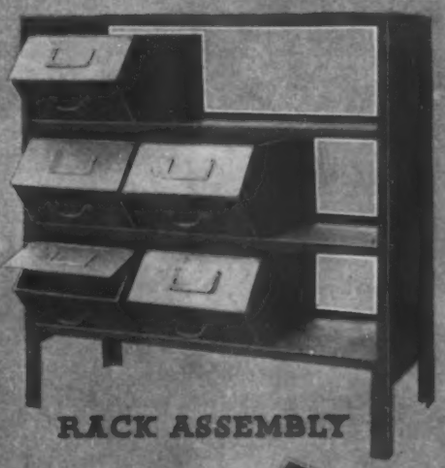
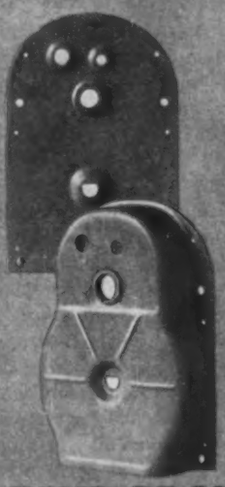


WASHING MACHINE TUB

IRONER SHOE



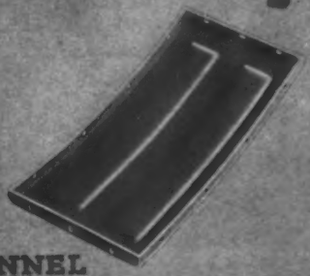
RACK ASSEMBLY



HAND BRAKE HOUSING

ALCHEMIK LINED BEER BARREL

GASOLINE PUMP HOUSING



TUNNEL LINER PLATE

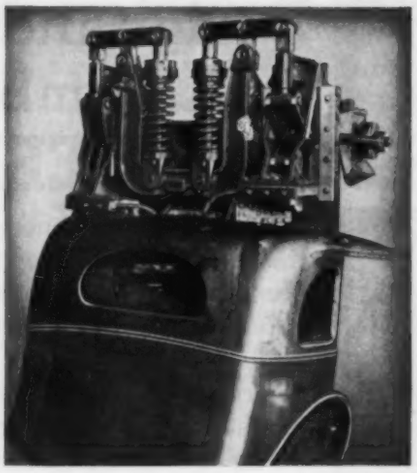
WHEEL HUB

AUTOMOBILE FRAME

**TRUSCON SETS THE STANDARD**

FORTY-EIGHT YEARS OF WELDING EXPERIENCE

A
**BODY MAKER**
*Gets*
**LOW COST**
*Plus*
**HIGH PRODUCTION**



*ON A FUSSY OPERATION . . . .*

This is only one of the many interesting installations of THOMSON-GIBB Welding Presses which are helping manufacturers bring their new cost and production schedules back into line. The machine shown is a special heavy duty two-head, double stroke projection welding press. Other standard machines, covering a wide variety of capacities and speeds, handle hundreds of operations on products large and small.

If you want more units per hour or lower welding cost per unit, a Thomson-Gibb Welding Press installation may be the easiest, quickest way. For preliminary facts and figures applying to your product and your conditions, fill in the coupon below and attach it to your letterhead.

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**Thomson-Gibb Electric Welding Company**
**162 Pleasant Street, Lynn, Mass.**

Gentlemen:

☐ Please ask your nearest engineer to arrange for an appointment at our plant.
☐ Please MAIL information on the welding of

Product..... Metal.....

Approximate dimensions.....

Desired production per hour.....

8070

# Getting Capital Back to Work

*(Continued from page 15)*

secure profits from them. Under unrestrained competition, the tendency is for the profits to disappear in what amounts to a war of attrition. Stillman recently showed that the average final net profits of industry have been very small; profitless prosperity was an apt description.

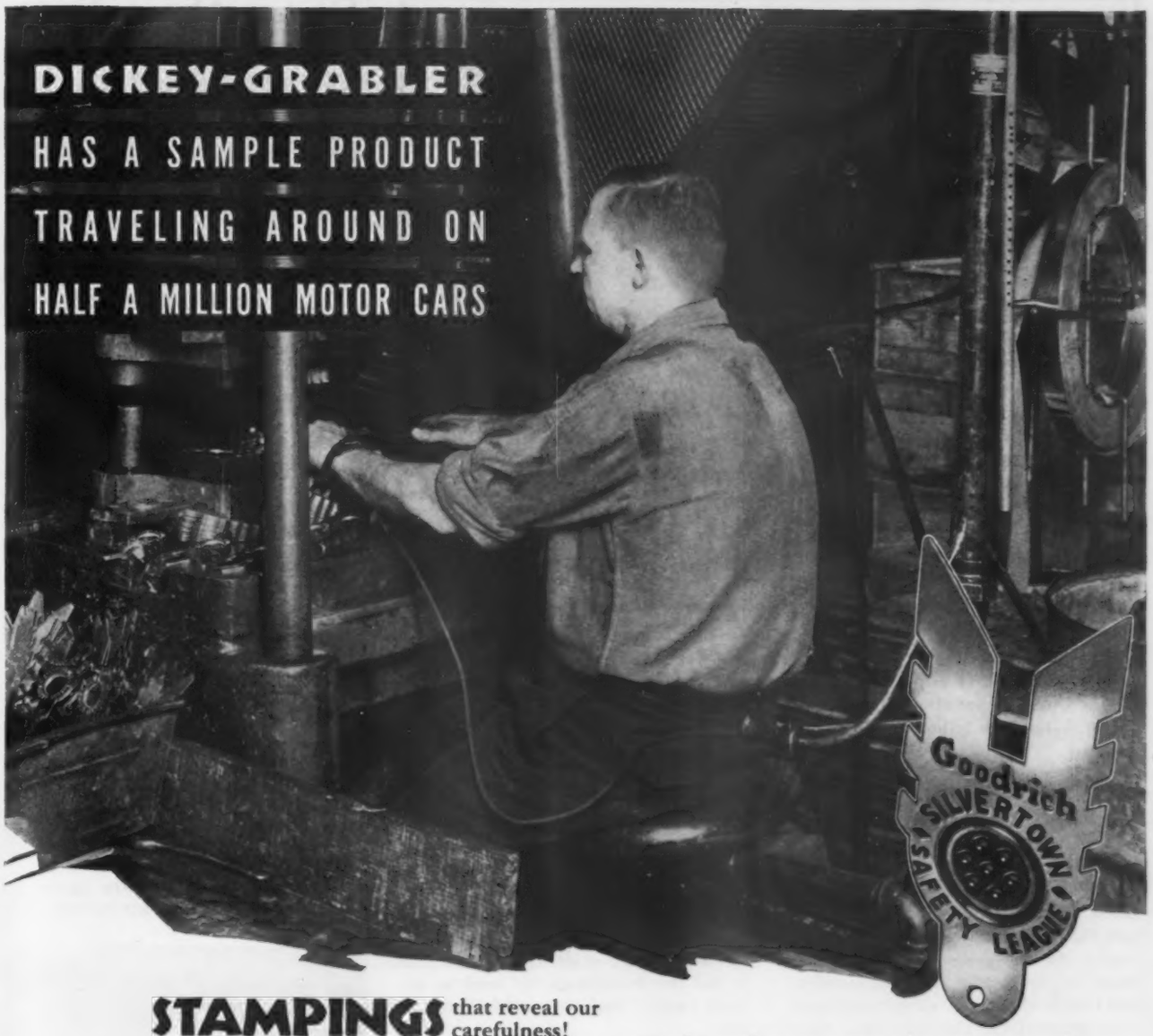
As discussion is now beginning as to what is to succeed the Recovery Act —and no one with a political sense expects its complete abrogation—it is timely to re-emphasize that unless we can include in our codes some measure of control over the rate of new installations, we will almost certainly run into a repetition of that profitless era, and a sterilization of engineering efforts to lift standards of living.

By no means is this to be construed as favoring any putting of brakes on new invention. We should put every new invention to work quickly. But at the same time, we have to remember that there are always more new inventions on the way. So the logical practice should be to schedule the life of equipment, replacing only the oldest by the newest, working all capital strenuously so as to keep a low average age; if we consistently each year throw out some old equipment which has paid for itself to make way for the newest available, we would have an average efficiency much nearer the known maximum than is now the case.

That implies a practical recognition that we cannot expect all-star performance from our machinery, any more than from personnel. Postponing renewals to await the ultimate in design is not only waiting for an impossible utopia, but actually blocks the progress gained by experience with each new step. Postponement of machine purchases to await new production set-ups and schedules is of course something else again; the consolidation of improvements into yearly models is often the most economical basis of procedure.

### The Railroad Situation

Railroad management seems to be suffering somewhat from that ultimate complex today. New designs of diesel-powered trains and aluminum freight cars and container devices have appeared in bewildering array. Yet it has been calculated that if the roads could make an investment now of some three billions in new motive power alone, it would show handsome profits—enough to pay for itself in two or three years—and junk most of the 40,000 locomotives over 10 years old which use excess fuel and maintenance. But with our shop capacity of only about 5000 locomotives a year (the peak output in recent years was 4360 for Class I roads) it would take eight years to do that job. If meanwhile the first ones will pay for themselves long before the transformation job is done, why wait for the ultimate? The case for planned schedules of replacement may be more apparent by a glance at locomotive production.* On the face of it, one would say it is a striking case of overcapacity—yet with planned schedules our locomotive shops might be as pushed for production as a war-time munitions plant. If the new railroad association can promote a policy of selecting each year the best available equipment, and placing orders on a basis say of retiring old equipment and replacing it with new if it will pay in two years, it could provide the equipment builders with steady employment at full capacity, reduce costs



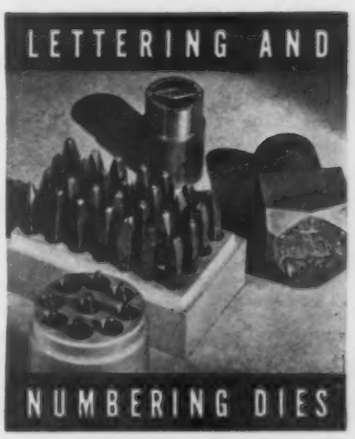

## STAMPINGS that reveal our carefulness!

If you ever signed up as a member of the world-famous Goodrich Silvertown Safety League you received, in the emblem of membership that Goodrich sent you, a first-class specimen of DICKEY-GRABLER stampings. Today this emblem is made of ENDURO stainless steel—an ever-lasting testimonial to the civic consciousness of Goodrich, and an easily recognized specimen of DICKEY-GRABLER quality of workmanship.

Examine one of these emblems closely for precision details in its stamping from stainless strip steel. It will give you a new appreciation of what DICKEY-GRABLER service means—for aside from enameling the lettering and affixing the light-reflecting red crystal jewel, after the stamping operation, no other operations are required. When this emblem leaves the DICKEY-GRABLER dies, it is as nearly perfect as a stamping can be made.

Coin savings banks, jar caps, pipe cutter discs, casket hardware, invar struts, gasoline pump indicators, faucet handles—a thousand-and-one different items are produced for as many manufacturers by DICKEY-GRABLER. Perhaps we could make something for you more economically than you can make it yourself. Remember, DICKEY-GRABLER *ships no rejects, for* DICKEY-GRABLER *has none.* Ask for quotations.

THE DICKEY-GRABLER COMPANY, 10304 Madison Ave., Cleveland, Ohio; *Detroit Representative:* Mr. Harry O. Turner, 514 Buhl Building, CADillac 8428.

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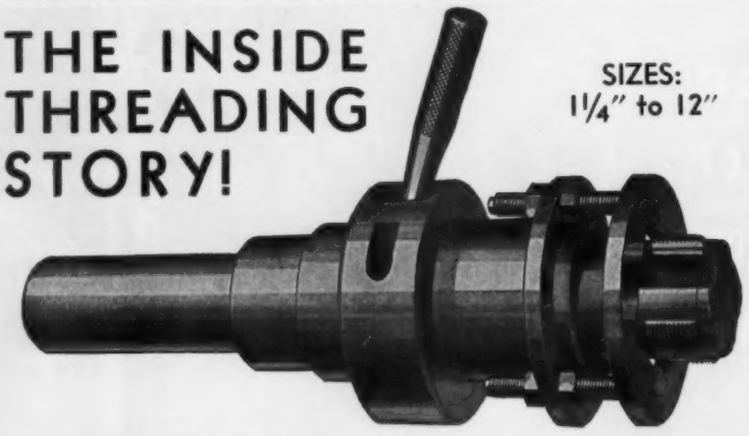
● *Dickey-Grabler makes a complete line of Brass Checks and Name Plates*

MORE THAN 50 YEARS OF SERVICE

# THE INSIDE THREADING STORY!

SIZES:
1¼" to 12"



For tapping blind holes where a shoulder creates an extra tap hazard—you need the new Murchey Collapsible Tap.

A positive chaser collapse by cam and rollers, and hardened guides for the chasers to move in create the sensitivity and positiveness of action which spells success for these tapping operations.

This tap may be used for both stationary and rotating operation. Want further details?

**MURCHEY MACHINE & TOOL CO.,** 951 Porter St. Detroit, Mich.


of transportation, and stimulate further development of design as a basis of procuring further steady business—and it should be a billion dollar a year business.

### Competitive Industry

The case in competitive industry is less clear-cut. Until we have means of restricting capacity in developed industries to a reasonable safety margin above known requirements, we shall lack that essential element of security needed to encourage capital investment. In the face of clear demonstration that real profits—as distinguished from promotional plunder—have been below a fair rate of growth (true interest) it is idle to contend that we have had expansion before, without protection. The owner of capital has found his investments in fixed assets so vulnerable, that he is extremely reluctant to keep his wealth in any but liquid form; admittedly, he foregoes many opportunities of profit, but as conditions are today, he often stands to gain more and lose less by holding wealth in raw commodities than in fixed assets.

If therefore the durable goods industries propose in certain cases a modified form of monopoly, with adequate regulation, that may be decidedly to public advantage. The provisions to protect public interest will be that the virtual licensing of capacity should be restricted to developed industries, with each case decided on its merits; some 10 per cent reserve capacity over normal demonstrated requirements should be maintained; there should be at least two or three competing units or groups within the monopoly framework; frequent accounting should be made public, to show investments made and retired, wages and salaries paid, operating expenses, and the course of costs and prices—to the end that ownership, labor and customer each see they are getting a fair deal. Under such conditions, it would become possible to use capital intensively—and recover it quickly by small profits on quick turnover, before it is destroyed by obsolescence or idleness. That seems to me the framework we need to attract capital back into useful production.

## TRADE NOTES

**Florandin Equipment Co.**, New York, has *moved from 40 West Fortieth Street to 136 Liberty Street.*

**Norma-Hoffmann Bearings Corpn.** of Stamford, Conn., manufacturers of precision ball and roller bearings, announces the appointment of E. W. Lawrence as its Southern representative. He has for the past eleven years been connected with the New York sales office.

**Metal Package Corpn.** has taken title to a plant and 97,240 ft. of land at 71 Locust Street, Boston, Dorcester District, and will improve for production purposes.

**St. Louis Heating Co.**, 2901 Elliott Street, St. Louis, manufacturer of furnaces and air-conditioning units, has changed its name to Home Comfort Furnace & Mfg. Co.

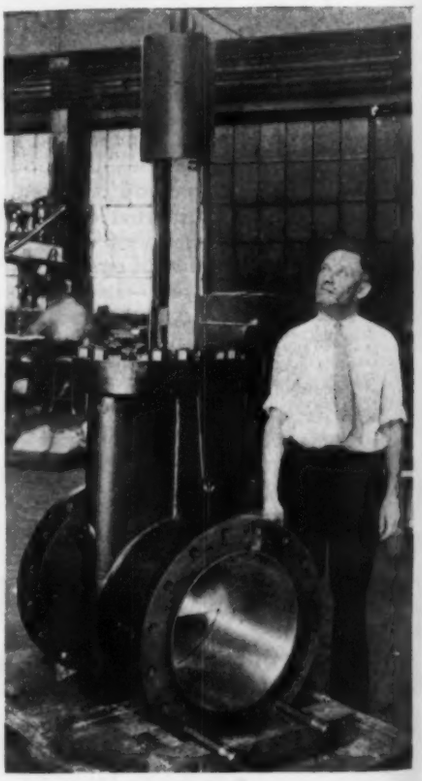
**Spot and Butt Welders.**—Eisler Engineering Co., 759 South Thirteenth Street, Newark. Catalog No. 35 W. contains illustrations and specifications of several types of spot and butt welders as well as wire, portable and special welders, saw brazing machines, spot welding timers and welding accessories. Useful tables and data pertaining to spot and butt welding are included.

## Simulate Altitude In Navy Carburetor Tests

TWO large adjustable orifices have been purchased from Bailey Meter Co., Cleveland, by the U. S. Navy for use in testing aircraft carburetors under actual flying conditions.

One of these orifices will be installed in a 16-in. line and the other in an 8-in line, carrying air to carburetors on test. This air will vary in temperature from minus 60 deg. F. to plus 200 deg. F. and will be at approximately atmospheric pressure when measured. A refrigeration system, a heating plant and a throttling device are included in the test set-up so that air conditions may be varied to simulate flying conditions either at sea level or at altitudes up to 30,000 ft.

The adjustable orifice, it is said, accurately measures a wide range flow, in the 16-in. size, for example, the gate segment may be set to accommodate a maximum capacity of 450 lb. per min. of 200 deg. F. air as well as a minimum capacity of 20 lb. per min. of —60 deg. F. air with equal accuracy. This high accuracy over a wide range of capacities is accomplished by a micrometer adjusting screw which permits setting of the gate segment to within 0.001 in.

To readjust the capacity of the orifice, it is only necessary to set the micrometer screw at a reading corresponding to the desired capacity as obtained from curve sheets furnished with the orifice.

The gate segments are made of Monel metal to eliminate corrosion.